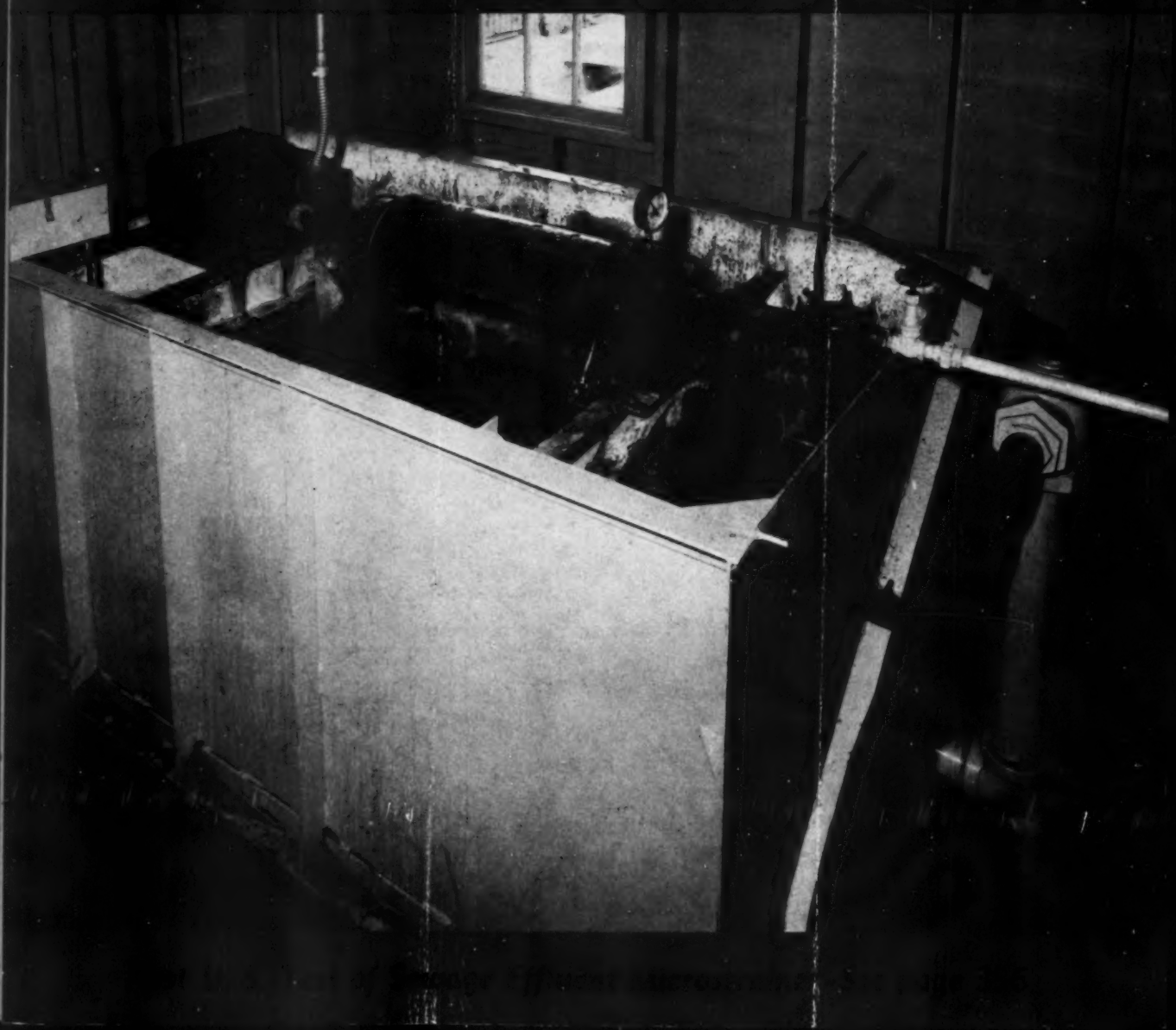
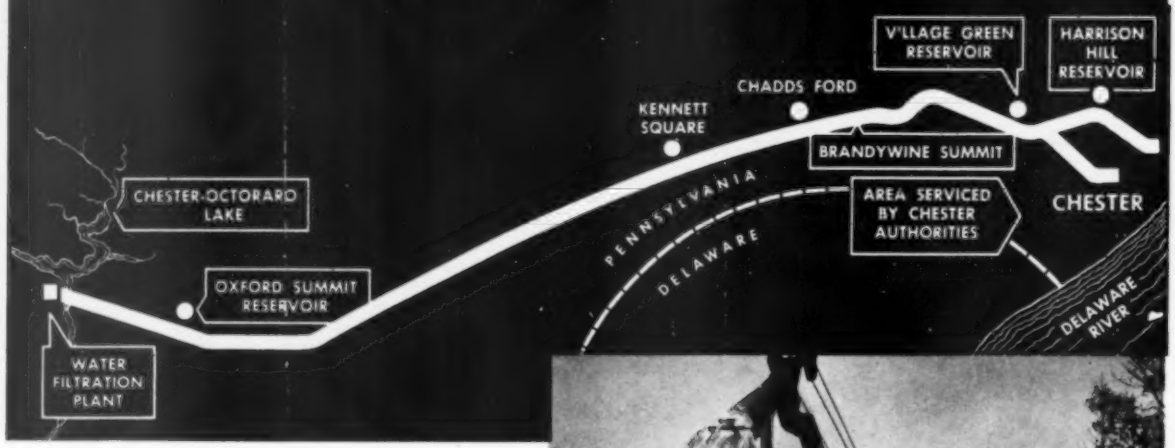
WATER & SEWAGE WORKS

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



a 44 mile LOCK JOINT pipeline

...with a Hazen-Williams "C" of 150



IN TESTS on 233,000 feet of 24", 30", 36", 42" and 48" Lock Joint Prestressed Concrete Cylinder Pipe in Chester, Pa. the eminent hydraulist, F. C. Scobey, found a coefficient of 150. This gives the city a premium capacity of 11%. Leakage was a mere 12% of the maximum allowed by the Consulting Engineers. Thus Chester enjoys greater capacity with far less waste than the city anticipated—truly premium performance in every sense. For similar trouble-free operations, let Lock Joint supply your needs in pressure pipe 16" and larger.

▲ *Laying a section of the 48" pipe for the Chester Water Supply Main*

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

SEWER & CULVERT PIPE PLANTS:

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LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

Thousands of feet of Vitrified Clay Pipe sewers are being installed to serve many aircraft defense workers who live in this Santa Monica, Calif., residential area. The project is being handled by contractors N. J. Tomovich and J. P. Evans.

Wherever There's Expansion ... Clay Pipe is *first choice for SAFE SEWERAGE!*

Ask the officials and engineers of almost any expanding locality, and they will tell you that Vitrified Clay Pipe is the *first-choice sewerage material* to meet the requirements of growing areas.

In one project after another, you find that Clay Pipe is first choice for availability, easy installation, and never-wear-out performance.

When a project is being financed over the years by a bond issue, Clay Pipe is a "must," because it is *guaranteed for 50 years.* Whenever you specify, buy or install sewer lines, insist on the performance-proved material . . . Vitrified Clay Pipe.

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C-354-1

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economically...effectively

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MATHIESON

MATHIESON CHEMICAL CORPORATION

Mathieson Industrial Chemicals Division

Baltimore 3, Maryland

J. R. Rossum, *sanitary engineer,* California Water Service Co., San Jose, California, a pioneer in using HTH Tablets for the disinfection of new mains, reports that "our use of HTH Tablets has proved most convenient and effective. The table below can be followed to obtain a minimum chlorine dose of 30 ppm."

Length of Section	Diameter of Pipe Line or Main					
	2"	4"	6"	8"	10"	12"
13'	*1	1	1	2	3	3
18'	1	1	2	2	3	5
20'	1	1	2	3	4	5
30'	1	1	2	4	5	7
40'	1	2	3	5	7	10

*Recommended number of HTH Tablets to be used per section.

2497

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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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In two continuing series of articles
"WATER WORKS PRACTICES" are discussed by *Dr. George Symons*
"SEWAGE WORKS PRACTICES" are discussed by *Prof. Don Bloodgood*

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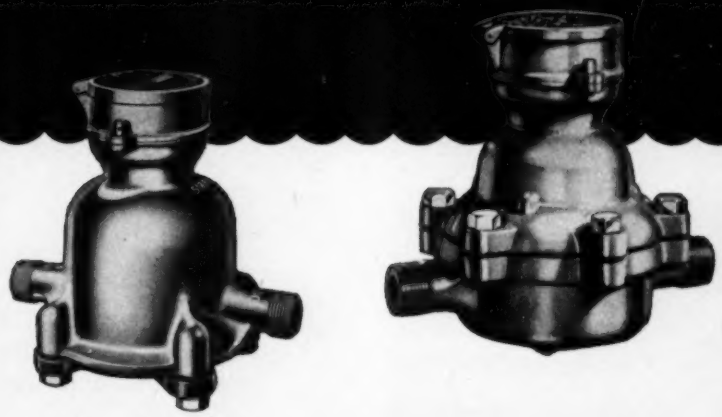
Water is vital...

BADGER meters conserve it BETTER!



THE cropless wastes of America's once-fertile Southwest have proved it again . . . water makes the difference between food and famine! Today, just to have water to drink, thousands of farmers and ranchers must haul water from nearby towns. With water supplies so low, Badger meters are almost as vital as the water itself. They provide a precise check on usage and waste . . . assure a fair allotment of the water available . . . and help water departments get a fair price for water and service. Thus, Badger meters help keep waterworks self-supporting for thousands of communities. And they operate dependably, economically, with a minimum of servicing.

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our integrated operation means undivided control of quality

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We are a wholly integrated pipe-producing unit — with mines, quarries, blast furnaces and laboratories under one direction and control.

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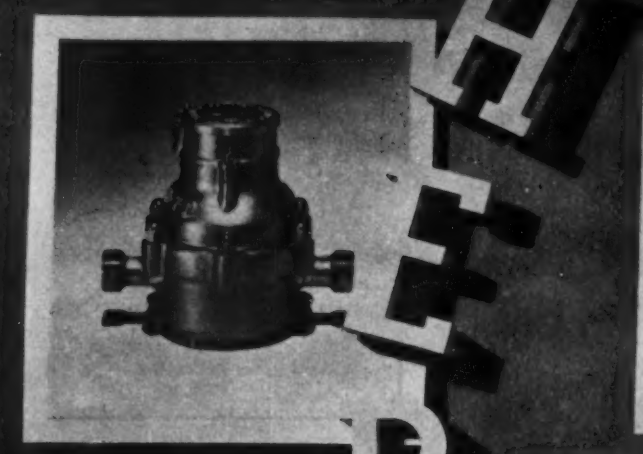

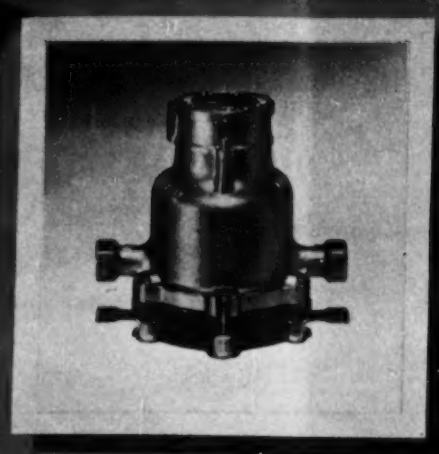

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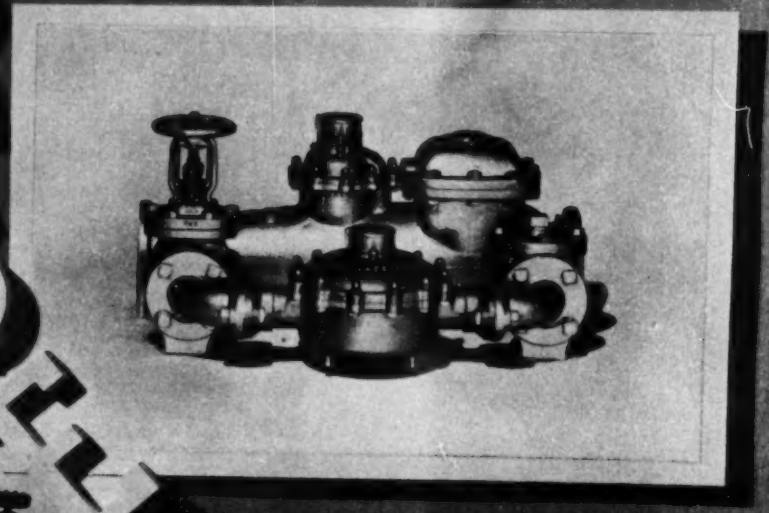

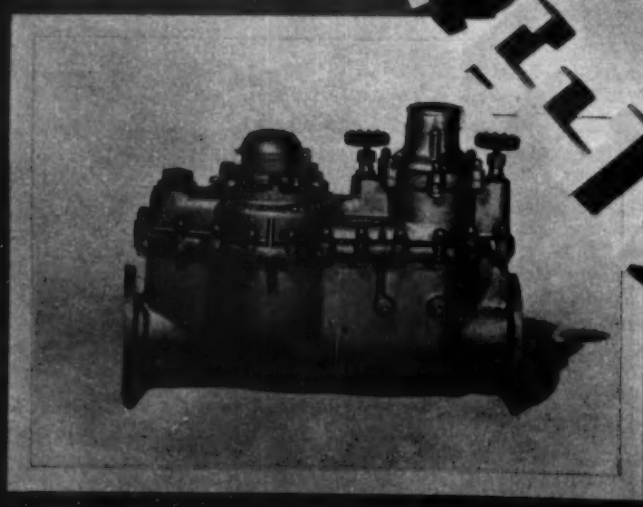

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has been building WATER METERS for more than 67 years. There is a HERSEY Water Meter for every need, be it for measurement of a trickle or a torrent. HERSEY Water Meters will give you the greatest satisfaction.

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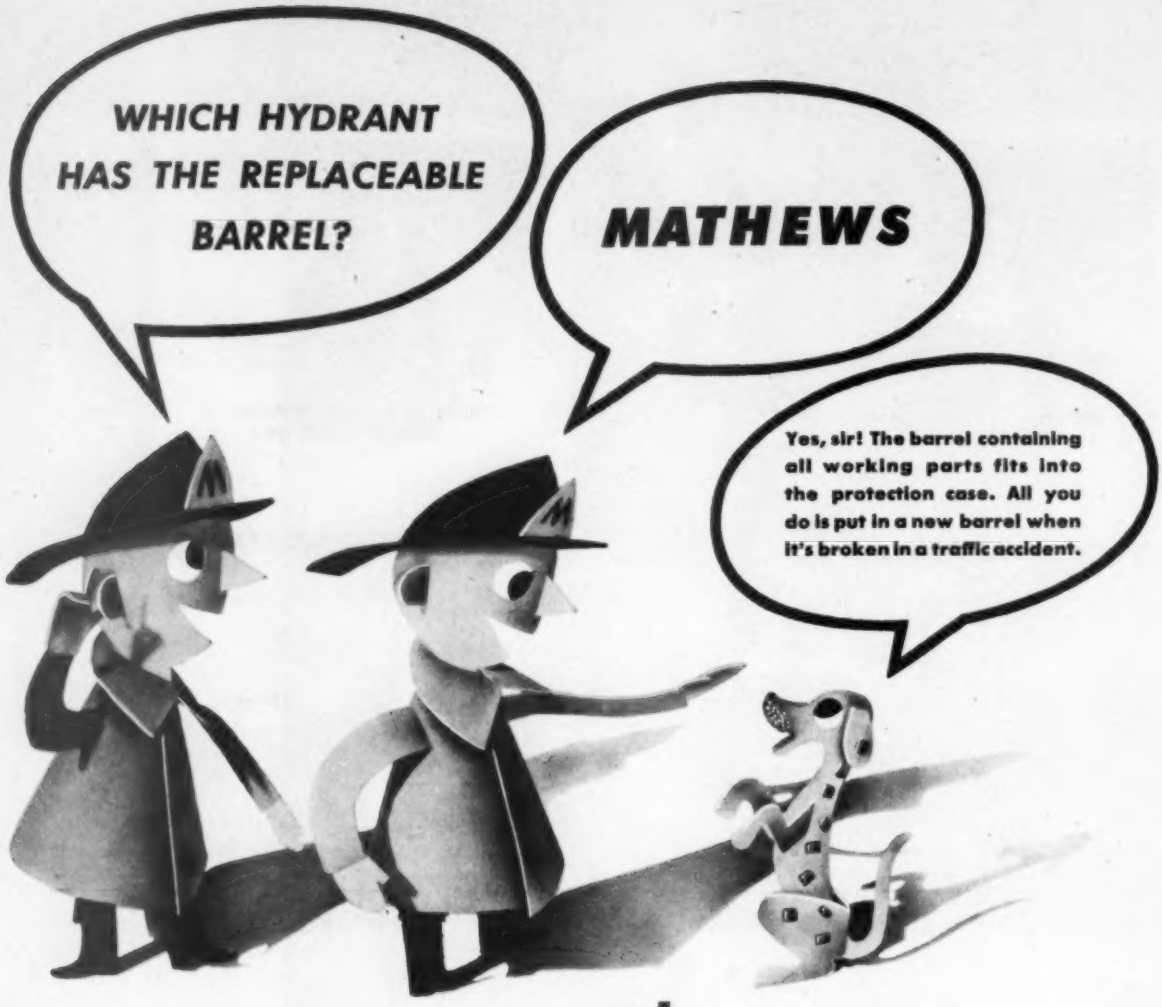
WHICH HYDRANT HAS THE REPLACEABLE BARREL?
MATHEWS
Yes, sir! The barrel containing all working parts fits into the protection case. All you do is put in a new barrel when it's broken in a traffic accident.

MATHEWS Means Fire Protection

LONG LIFE. Mathews Hydrants are protected at wear points by bronze bushings — corrosion and rust are thoroughly licked.

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LOW-COST MAINTENANCE. Only one point requires lubrication — and that only during routine inspections.

REPLACEABILITY. A Mathews leveled in an accident can be replaced without excavating and in a jiffy. Community fire protection is interrupted only for a few minutes.

The Mathews includes every quality feature . . .

Compression type valve to prevent flooding • Head turns 360° simply by loosening bolts • Replaceable head • Nozzle sections easily changed • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • A modern barrel makes an old Mathews good as new • Mechanical-joint pipe connections as needed

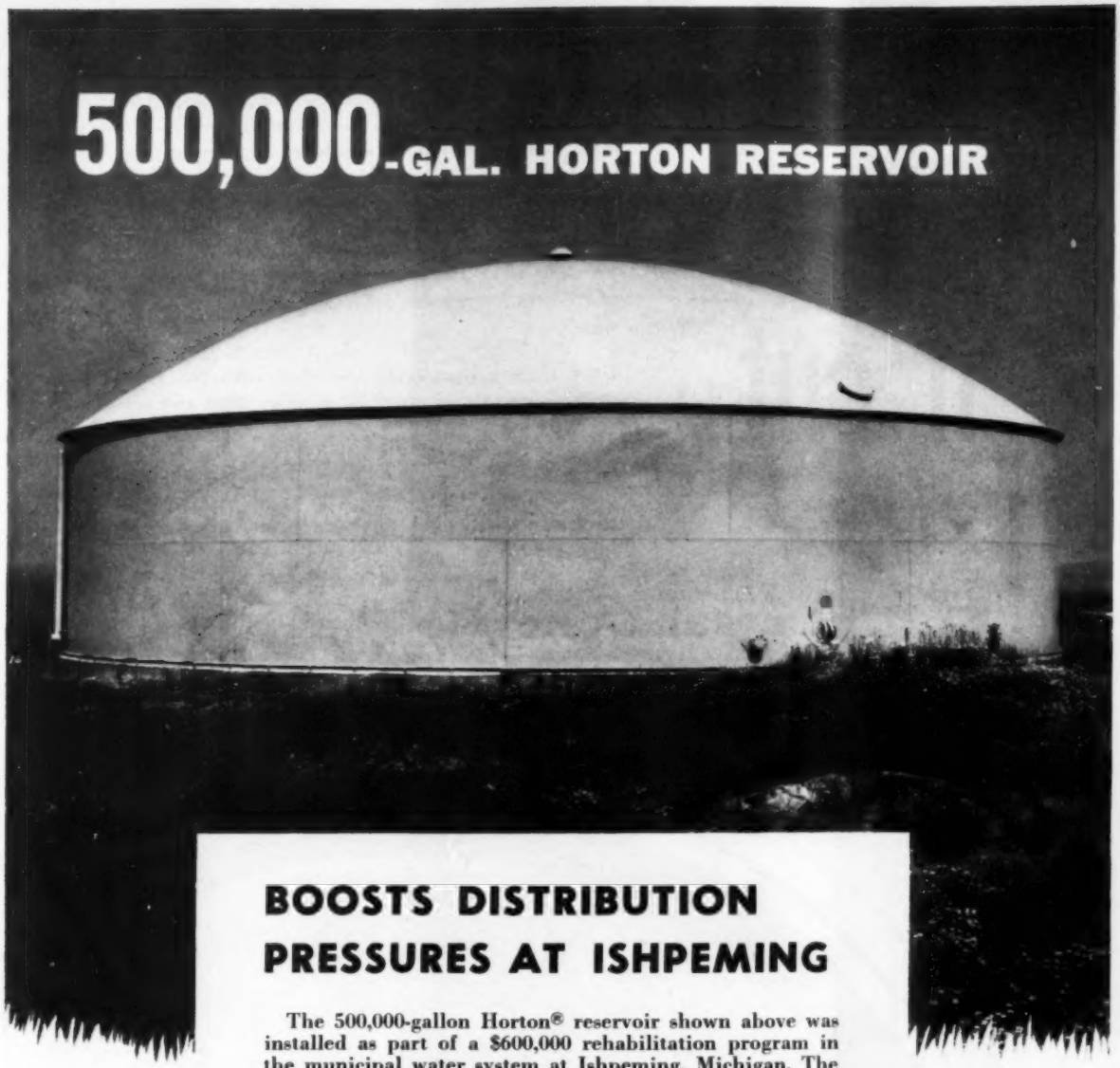
MATHEWS HYDRANTS

Made by R. D. Wood Company

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

500,000-GAL. HORTON RESERVOIR



BOOSTS DISTRIBUTION PRESSURES AT ISHPEMING

The 500,000-gallon Horton® reservoir shown above was installed as part of a $600,000 rehabilitation program in the municipal water system at Ishpeming, Michigan. The reservoir, located high on a hill so that water flows from the reservoir into the system by gravity, helps maintain distribution pressures at a constant 65 to 70 lbs. per sq. in. throughout the city and outlying communities.

Horton reservoirs, similar to the Ishpeming installation, are built in standard capacities to 10,000,000 gallons. We also build elevated water tanks, Waterspheres and standpipes. Write our nearest office for help in choosing the type of storage to best improve your water system. There is no obligation on your part.

HORTON

WELDED STEEL

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Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
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Havana	402 Abreu Bldg.	Seattle 1	1350 Henry Bldg.
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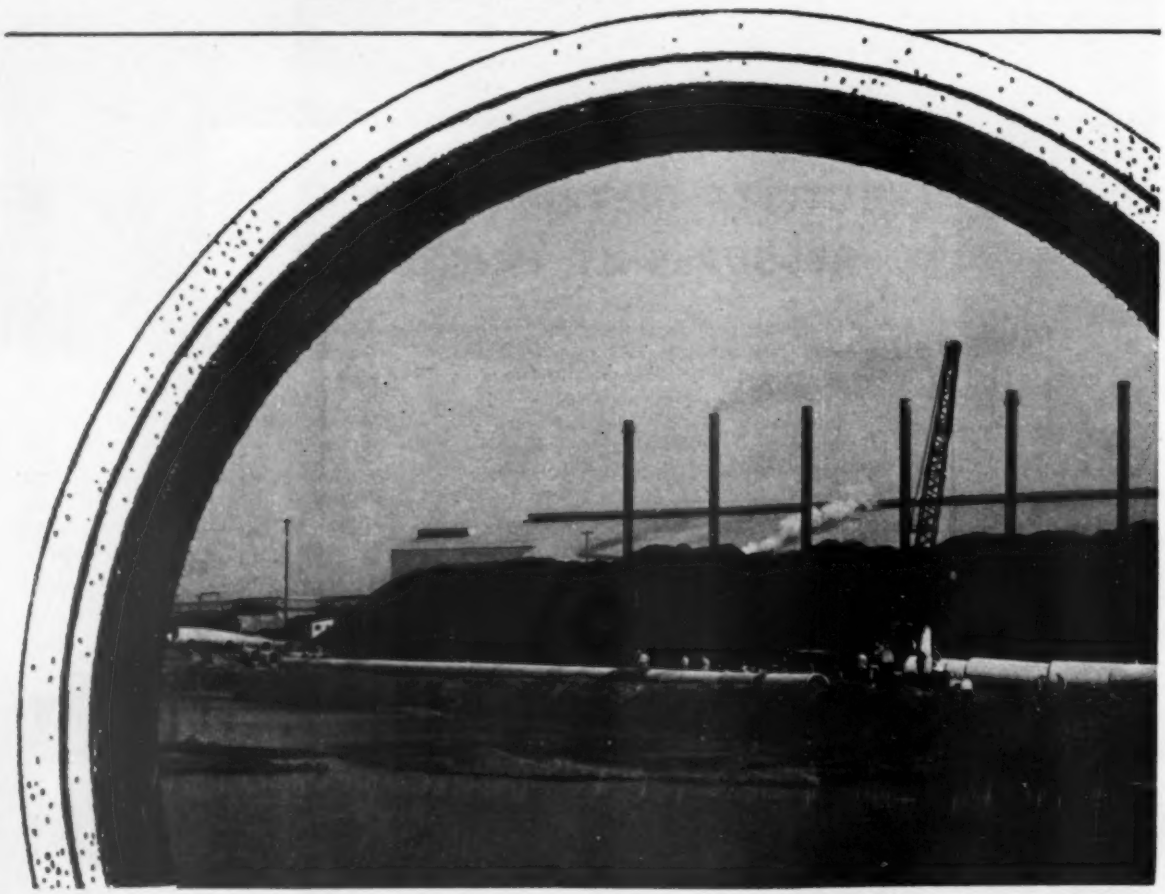
Universal produced two miles of 48-inch concrete pressure pipe, in 16-foot lengths, for U. S. Steel Corporation's newest operation. All this is to bring water in.

Universal also provided the reinforced concrete sewer pipe to carry out the water wastes and sewage at Fairless.

In 'n Out goes the water at Fairless through the best concrete pipe that can be made — a Universal certainty at any of its 25 plants throughout the country.

Universal Concrete Pipe Co.

297 S. High St., Columbus 15, Ohio
A Subsidiary of American-Marietta Co.



standardize on

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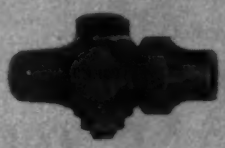
"B" Tapping and Inserting Machine
Drills and taps mains and inserts corporation stops, ¾" to 1", under pressure . . . also used for dry taps, ¼" to 2½" . . . similar machines available in larger sizes.

"C-1" Drilling Machine
Makes cuts 2" to 12" in any size main . . . dry or under pressure . . . power-operated by air motor or gasoline engine . . . hand-operated model also available.

a complete line of water works equipment

Low maintenance and high efficiency are characteristic of all Mueller water works equipment, supplies and specialities. Each item is engineered to do its specific job and is manufactured from the finest of materials — guaranteeing long, trouble-free life. A high degree of standardization and interchangeability requires a minimum inventory of replacement parts in case of accident or emergency. Mueller's complete line of products, a few of which are shown, provides a single source for your water works needs. All products are fully tested and warranted.

Corporation Stops
Designed for insertion into mains under pressure . . . ground key . . . wide range of sizes and types . . . variety of inlet and outlet threads and connections.

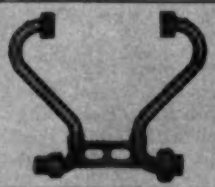


Service Clamps
For use on all types of pipe . . . single or double strap . . . full depth tapped hole . . . Neoprene or lead ring gasket . . . all sizes and threads available.

Curb Boxes
Telescoping type . . . prevents damage to stop or piping . . . large steel upper section will not revolve in base. Bronze-to-iron threads for easy plug or lid removal . . . with or without stationary rod.

Curb Stops
Ground key stops . . . proper taper prevents sticking . . . allows easy operation . . . inverted key or solid tee head type . . . wide range of sizes and connections.

Meter Setting Equipment
Copper meter yoke with multi-purpose end connection . . . iron meter yokes . . . plain or lock wing angle stops . . . meter couplings . . . complete line available . . . variety of inlets and outlets.



Regulators and Relief Valves
Large diaphragm type . . . all working parts accessible without removing from line . . . high or low pressure . . . for water, air, gas or oil.

Fire Hydrants
Improved and standard types, sizes to 6¼" valve opening . . . compression type . . . locked-in nozzles . . . safety flange minimizes collision damage . . . 2½" size and flush type also available . . . AWWA.

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Exclusive "four-point contact" disc wedging mechanism . . . fully bronze-mounted . . . conventional or "O" ring stem packing . . . rising or non-rising stem . . . AWWA.

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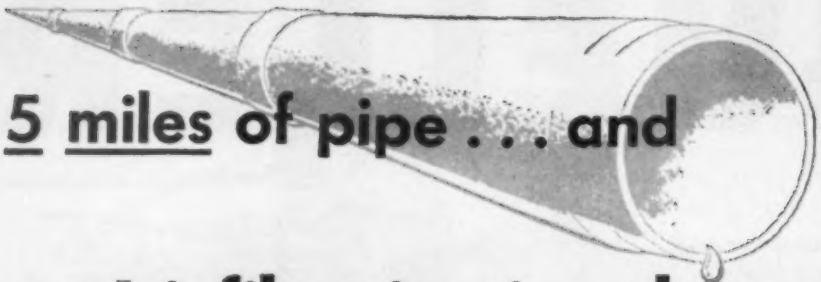
Designed for installing in line without a shutdown . . . operated like gate valve after installation . . . parts interchangeable with AWWA gate valve . . . 4", 6" and 8" sizes.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



5 miles of pipe . . . and total infiltration is only a trickle . . .

. . . with Transite® Sewer Pipe

THE REDUCTION of ground-water infiltration brought about by the Ring-Tite® Joint—now standard on all sizes of Transite® Sewer Pipe—can lead to a number of cost-saving results.

For example, on one recently installed Ring-Tite System using 28,540 feet of Transite Sewer Pipe, in diameters of 6 through 18 inches, the infiltration per inch of diameter, per hour, per mile of pipe came to a mere 0.85 gal. This low infiltration (including that from manholes and connections to house sewers) was achieved despite the fact that a considerable portion of this installation was below the prevailing ground water table. (For specification purposes, an infiltration allowance of 10 gallons per inch of diameter, per hour, per mile of pipe may be used with Transite Sewer Pipe.)

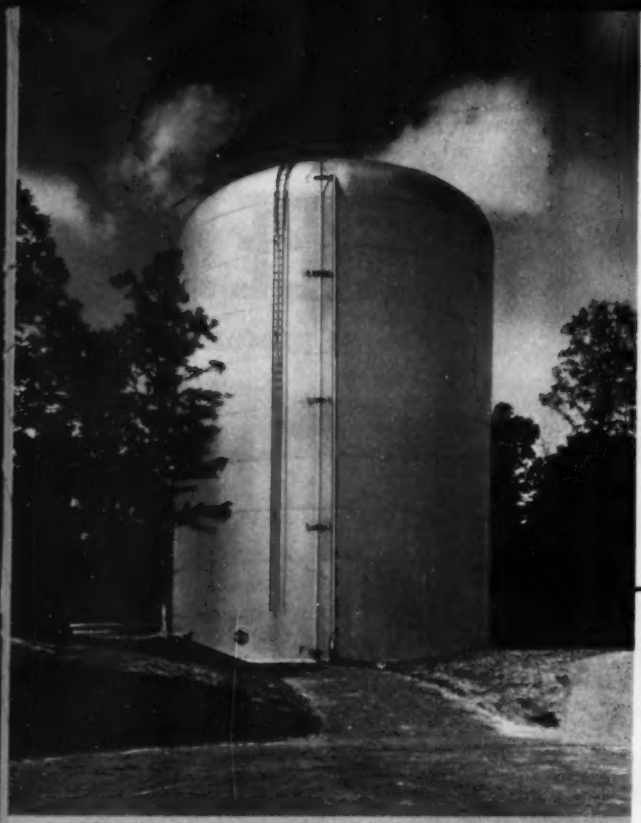
Obviously, such minimum ground-water infiltration helps reduce the load on treatment plants, cuts down on treatment costs, and conserves plant capacity for future expansion needs. This reduced infiltration plus Transite's high flow capacity (Manning's N=.010) often permits the use of smaller diameter pipe for new installations.

For further information on how this Ring-Tite Joint, used with corrosion resistant asbestos-cement Transite Pipe can help reduce your sewage costs, write Johns-Manville, Box 60, New York 16, N. Y. Ask for folders TR-103A and TR-94A.

Tells more about Transite asbestos-cement Sewer Pipe with Ring-Tite joints—for non-pressure service. Ask for Brochure TR-103A.

Helpful to Engineers— Sewer Design Flow Chart Based on Manning Formula. Ask for Brochure TR-94A.

Johns-Manville TRANSITE SEWER PIPE



FAIRFAX, VIRGINIA. Steel standpipe, 900,000 gallons capacity. Diameter 48 ft., head range 67 ft.

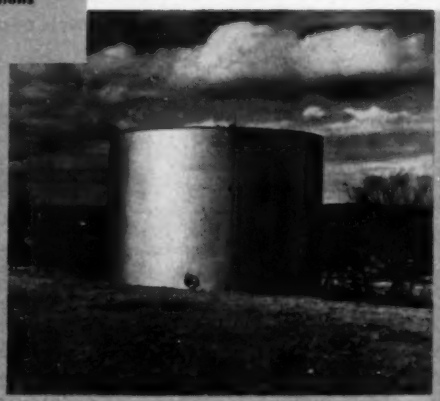
Where natural elevations are available, **choose**

PITTSBURGH •DES MOINES

Steel Reservoirs and *Standpipes*

for maximum economy in better water supply

OTTUMWA, IOWA. Steel reservoir, 4,200,000 gallons capacity. Diameter 110 ft., head range 60 ft. 4 in.



LIBERTY, NEW YORK. Steel reservoir, 300,000 gallons capacity. Diameter 42 ft., height 29 ft. 3 in.

ST. PAUL, MINNESOTA. Steel reservoir, 2,000,000 gallons capacity. Diameter 70 ft., head range 70 ft.

The strength, endurance and low cost of Pittsburgh-Des Moines All-Steel Reservoirs and Standpipes meet every requirement of service and economy wherever terrain is advantageous. A wide range of standard and special designs is available, fabricated and erected with skill and experience. *Let us quote on your projected needs.*

PITTSBURGH-DES MOINES STEEL CO.

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Sales Offices at:

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CHICAGO (1)	1222 First National Bank Bldg.	SEATTLE	526 Lane Street
LOS ANGELES (48)	6399 Wilshire Blvd.	SANTA CLARA, CAL.	625 Alviso Road

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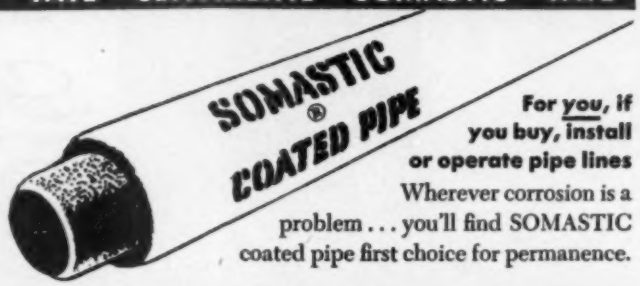
source of supply — **pipe line processes**

TATE • CENTRILINE • SOMASTIC • TATE • CENTRILINE • SOMASTIC • TATE

1

SOMASTIC® PIPE COATING

Pipe Linings, Inc. manufactures and applies the world-famous and proven SOMASTIC Pipe Coating for exterior protection against corrosion in the 11 Western States and All Foreign Locations.



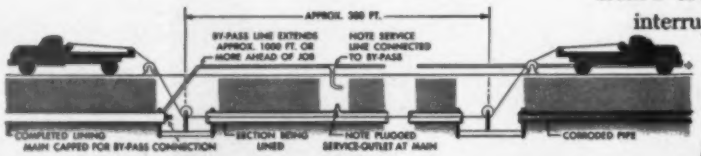
For you, if you buy, install or operate pipe lines

Wherever corrosion is a problem . . . you'll find SOMASTIC coated pipe first choice for permanence.

TATE • CENTRILINE • SOMASTIC • TATE • CENTRILINE • SOMASTIC • TATE

2

THE TATE PROCESS, applicable to water, oil and gas pipe lines, renews old iron and steel pipe "in place" as shown here in the schematic drawing. The Tate Process is used for pipe lines from 4" to 16" in diameter. Only momentary interruption to service is necessary while by-pass sections are installed.


APPROX. 500 FT.
BY-PASS LINE EXTENDS APPROX. 1000 FT. OR MORE AHEAD OF JOB
NOTE SERVICE LINE CONNECTED TO BY-PASS
COMPLETED LINING
MAIN CAPPED FOR BY-PASS CONNECTION
SECTION BEING LINED
NOTE PLUGGED SERVICE-OUTLET AT MAIN
CORRODED PIPE

TATE • CENTRILINE • SOMASTIC • TATE • CENTRILIN

3

THE CENTRILINE PROCESS is used for lining 16" to 144" pipe lines "in place." Cost is much less than the cost of installing new pipe. Premixed cement-mortar is thrown by centrifugal force, at uniform high velocity, against the inside surface of the pipe, and then mechanically troweled to a smooth, even finish. Centrilining is applicable to fresh or salt water, oil, sewage, gas or industrial waste lines, sewers and drains.

You Get These Advantages From Cement Mortar Lining!

- **New pipe performance**
- **Prevents leakage**
- **Restores full flow coefficients**
- **Reduces pumping and maintenance costs**
- **Protects against corrosion, contamination and discoloration at much less than the cost of installing new pipe!**

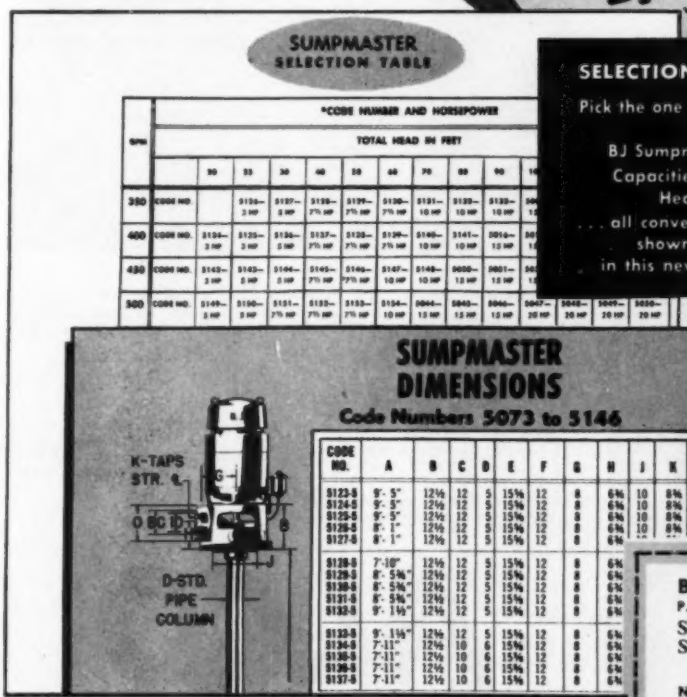
Complete mobile equipment and expert crews are available to bring new efficiency to your old pipe. A Pipe Linings, Inc. hydraulic engineer will be glad to discuss your problem. No obligation!

PIPE LININGS, INC.

In your hand **ALL the answers to sump pump selection!**

4000 standard combinations at your fingertips

Sample pages from bulletin



SELECTION *right now*

Pick the one best pump for your job from 4000 standard BJ Sumpmaster combinations . . .
Capacities: 10 to 2600 GPM
Heads: 20 to 300 ft.
. . . all conveniently, concisely shown in easy selection charts in this new 20-page bulletin.

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You can draft exact specifications without a minute's delay. No waiting, no correspondence needed. This new BJ Sumpmaster bulletin provides complete dimensions and outline drawings.

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No special engineering or custom production delays are involved. Delivery can be made from Los Angeles, California, or Lawrenceburg, Indiana. Ordering is made easier by simple coding which eliminates detailed descriptions!

BYRON JACKSON CO. PUMP DIVISION
P. O. Box 2017, Terminal Annex, Los Angeles 54, California
Send me _____ copies of your new BJ Sumpmaster Selection and Specification Bulletin.

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Title_____
Co._____
Address_____
City_____ Zone_____ State_____

STEEL PIPE helps cut cost of Philadelphia's long-range program of waterworks improvement

The tracks you see in the first photo below are part of the Pennsylvania Railroad's main line. That's one reason why the pipes passing under the tracks are built of strong, *electric welded steel.*

Engineers know from experience that Alco Electric Welded Steel Pipe has the strength and resilience to absorb vibration, impact and overloading that destroy pipe of other types. They know, too, that Electric Welded Steel Pipe offers still other advantages that help cut piping costs. For example:

Efficiency—Smooth, tar-enameled inside surface gives excellent rate of flow. *Economy*—not only is first cost low but sections are long and light, for fast, easy installation. And *durability*—estimated life is 75 to 100 years.

Alco makes Electric Welded Steel Pipe to meet AWWA and other specifications. Forty-foot lengths fabricated without girth seams in diameters of 30 in. and above. Under 30 in., lengths of 22 ft furnished without girth seam, or 40-ft lengths with one girth seam. Diameters range from 20 in. to 120 in.

Use Alco Electric Welded Steel Pipe for your piping projects. Your nearest Alco Products Sales Representative will be happy to furnish you complete technical information and to discuss with you any special problems you may have.

Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

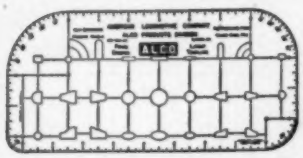
EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

ECONOMICAL: Low first cost. Long lengths, light weight, for easy installation.

DURABLE: Life in water-supply installations estimated conservatively at 75 to 100 years.

PHILADELPHIA used efficient, durable Alco Electric Welded Steel Pipe in diameters of 60, 54 and 48 in., with thicknesses of ½ and 5/16 in. Sections are joined with Dresser couplings.

SUBMERGED-ARC WELDING gives added strength, zero leakage. Machine shown here is part of the complete, modern facilities that enable Alco to build low-cost pipe for almost any project.



For information on how to obtain one of these handy Alco Piping Templates, write to your nearest Alco Products Sales Office.

ALCO

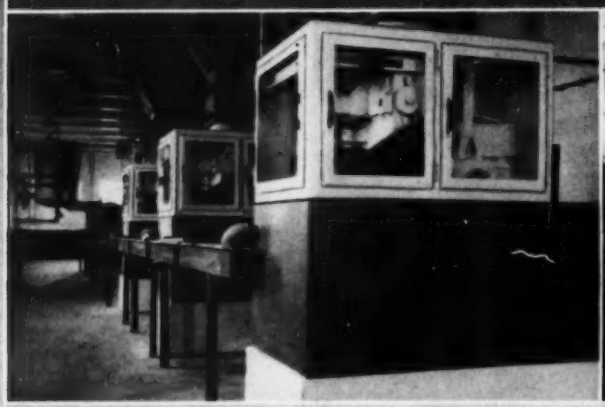
ALCO PRODUCTS DIVISION
AMERICAN LOCOMOTIVE COMPANY
DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles Kansas City, Houston, Tulsa and Beaumont.

SAVANNAH, GA.

Cherokee Hill Filtration Plant

J. E. SIRRINE COMPANY
Engineers
GREENVILLE, SOUTH CAROLINA



Omega Model 44-20 Belt Gravimetric (weighing) Feeders for lime, carbon, soda ash — equipped with Rotary Bin Gates, Dust Collectors, Extension Hoppers, and automatic-proportional controls from Venturi influent meter.

Omega Rotodip Liquid Feeder for feeding alum solution in response to continuous pH meter — using pneumatic control system.

With the completion of this modern filtration plant, Savannah increased its total water supply capacity by forty million gallons per day. The plant is the product of good municipal planning combined with competent engineering assistance. It utilizes many design advancements which provide high-level performance at low operating cost.

As in many filtration plants in this area, considerable emphasis is placed on efficient chemical treatment. Omega Chemical Feeders, arranged for automatic-proportional control, are of great assistance to B. J. Sams, Supt., in maintaining a high-quality effluent under all seasonal conditions. For complete information on Omega Water Works Equipment supplied for the Cherokee Hill Filtration Plant, address Omega Machine Company, Providence 1, Rhode Island.

OMEGA *THE LAST WORD IN* **FEEDERS**

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS

Boltite Mechanical Joint

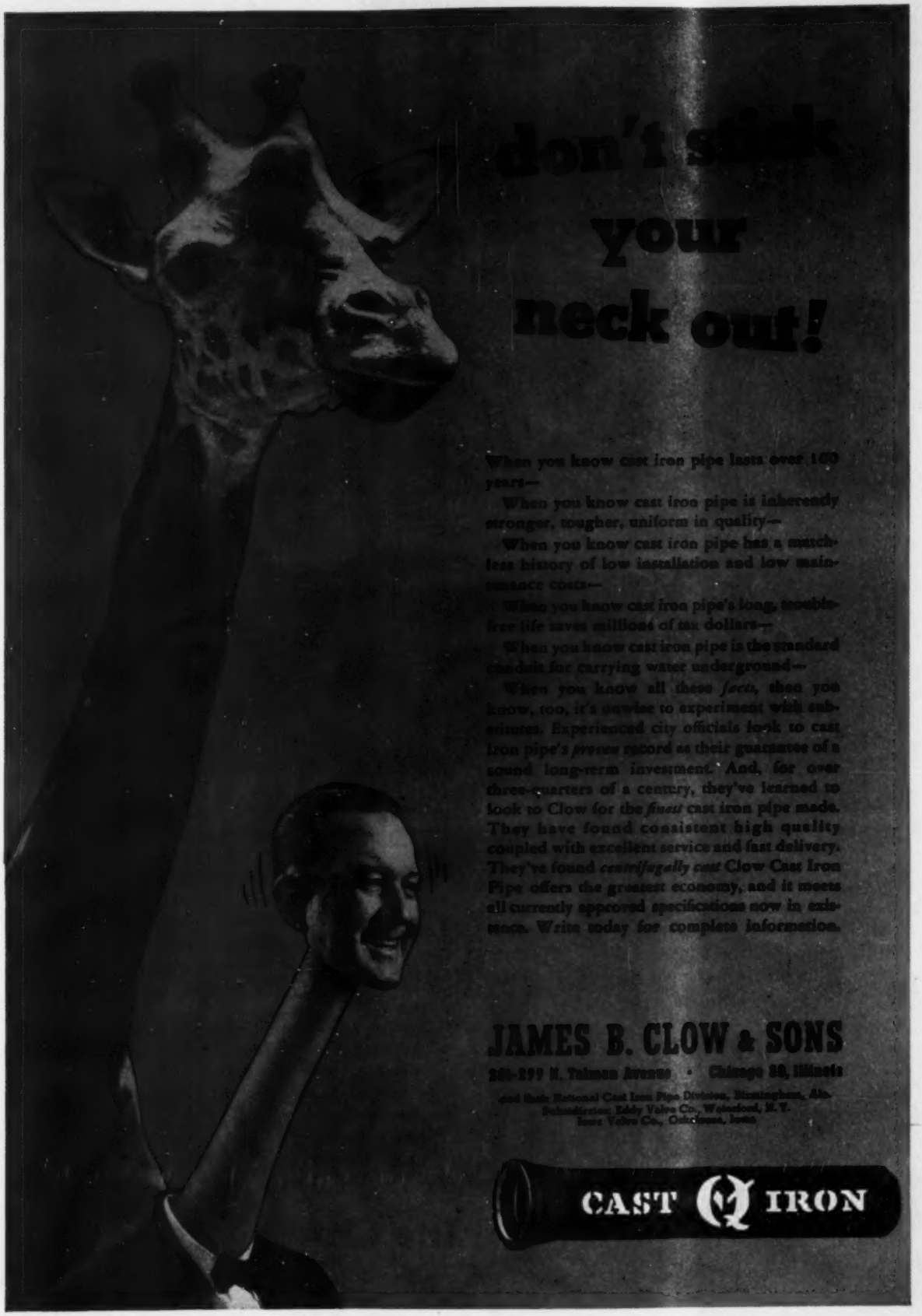
McWane 2¼" Cast Iron Pipe has been taken into the DeLavaud Centrifugal family. Mechanical Joint pipe 2¼" in diameter is now being cast centrifugally by McWane. After extensive research and experiments, we have recently completed construction of the only centrifugal small-pipe foundry in the United States producing Mechanical Joint Super-DeLavaud 2¼" Cast Iron Pipe in EIGHTEEN-FOOT lengths.

McWane-Pacific small diameter pipe has all the characteristics of Super-DeLavaud larger size pipe—smooth straight barrel, even cross section, sound metal free of blow-holes or casting defects, easy to tap or cut.

DeLavaud centrifugal casting of pipe in 4" sizes and up has been in successful operation for over 25 years. McWane's new Super-DeLavaud small pipe foundry probably is the most important development in the pipe industry since the invention of centrifugal casting.

McWane-Pacific 2¼" Cast Iron Pipe in 18-foot lengths is furnished with Mechanical joint and with complete line of fittings. Later, it will be made with bell-and-spigot joints and also in 2-inch diameter. The 2¼" size weighs approximately 6.8 lbs. per foot. It is easily handled and laid by two men. It is furnished uncoated, coated or cement lined. For complete information, wire or write McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales Offices in principal cities.)

McWANE PACIFIC PIPE *Lasts for Centuries*



don't stick your neck out!

When you know cast iron pipe lasts over 100 years—

When you know cast iron pipe is inherently stronger, tougher, uniform in quality—

When you know cast iron pipe has a matchless history of low installation and low maintenance costs—

When you know cast iron pipe's long, trouble-free life saves millions of tax dollars—

When you know cast iron pipe is the standard conduit for carrying water underground—

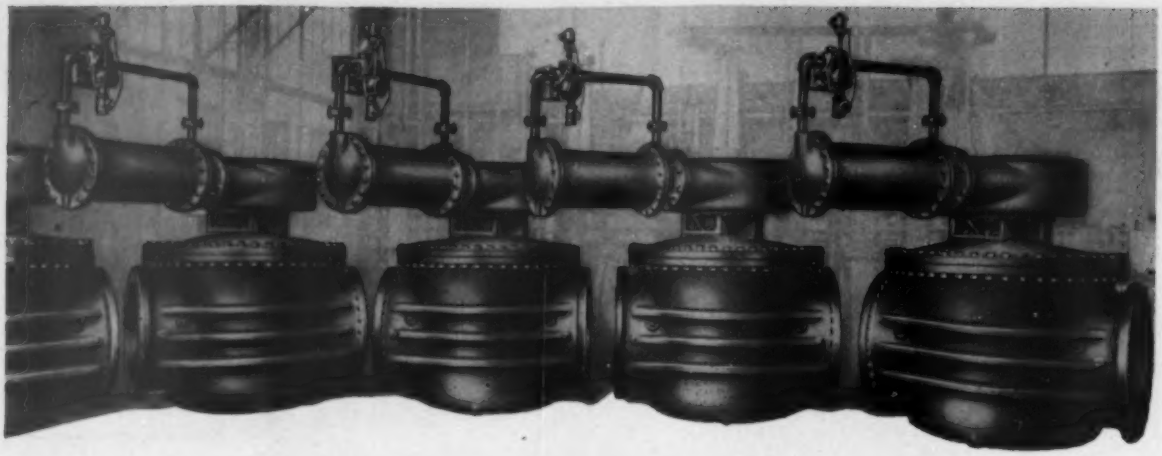
When you know all these *facts*, then you know, too, it's unwise to experiment with substitutes. Experienced city officials look to cast iron pipe's *proven* record as their guarantee of a sound long-term investment. And, for over three-quarters of a century, they've learned to look to Clow for the *finest* cast iron pipe made. They have found consistent high quality coupled with excellent service and fast delivery. They've found *centrifugally cast* Clow Cast Iron Pipe offers the greatest economy, and it meets all currently approved specifications now in existence. Write today for complete information.

JAMES B. CLOW & SONS

2201-2299 N. Talman Avenue • Chicago 18, Illinois

and Scott National Cast Iron Pipe Division, Birmingham, Ala.
Subsidiaries: Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

CAST IRON



36" CONE VALVES with clear OPENING

To supplement its hydro-electric power, TVA has built a series of steam plants on the Tennessee and Ohio rivers. These new units will furnish power required for Atomic Energy and other projects.

In this vital program, 52 Chapman Automatic Cone Valves were utilized for these plants . . . to act as check valves on the condenser water pumps. Each of these valves weighs approximately 11 tons.

Chapman designs and builds these valves in a range of sizes from 6" to 48" for check, throttling, pressure reduction and stop valve service. This is only one of many special Chapman valves. Remember, there's no problem in flow control that's too big or too tough for Chapman. That's why it saves time and money to *check with Chapman first, every time.*

The CHAPMAN VALVE
MANUFACTURING COMPANY
INDIAN ORCHARD, MASSACHUSETTS

Mono-Cast Roll-On Joint Pipe For Permanence!

AMERICAN Mono-Cast Roll-On Joint pipe is growing rapidly in popularity. This type of pipe is offered as an alternate for standard bell and spigot pipe with lead and jute joints, and has gained wide acceptance within a comparatively short period of fifteen years. Roll-On Joint is included in new Federal Specification WW-P-00421 as Joint Type II. Users of this type of cast iron pipe are enthusiastic about it.

Roll-On Joint pipe ,in sizes 2″ through 48″, is cast centrifugally by the Mono-Cast process in nominal 16-foot lengths. Standard joint materials, including rubber ring, jute and bituminous joint compound are furnished with the pipe. Having a positive rubber-packed bottle-tight joint, Roll-On is lower in first cost than other types of joints.

Pipe with the Roll-On Joints is easily and quickly assembled by unskilled labor. After assembly the joints will deflect easily and yet remain bottle-tight under pressure.

The above illustration shows 12″ Roll-On Joint pipe being used in the construction of a seven-mile-long pipe line in Kentucky. This pipe serves equally well in cross country installations or beneath crowded city streets.

AMERICAN works hand-in-hand with engineers, contractors, and superintendents in solving piping problems in their respective fields. Our unexcelled foundry facilities and highly trained and experienced organization prove exceedingly helpful in connection with pipe installations. Consulting with us will not impose an obligation.

Write for Roll-On Joint pipe literature, using coupon below.

AMERICAN CAST IRON PIPE COMPANY

BIRMINGHAM 2, ALABAMA

----MAIL COUPON FOR FREE LITERATURE----

American Cast Iron Pipe Company
Birmingham 2, Alabama

Gentlemen: Please send me a free copy of your new illustrated Roll-On Joint pipe literature.

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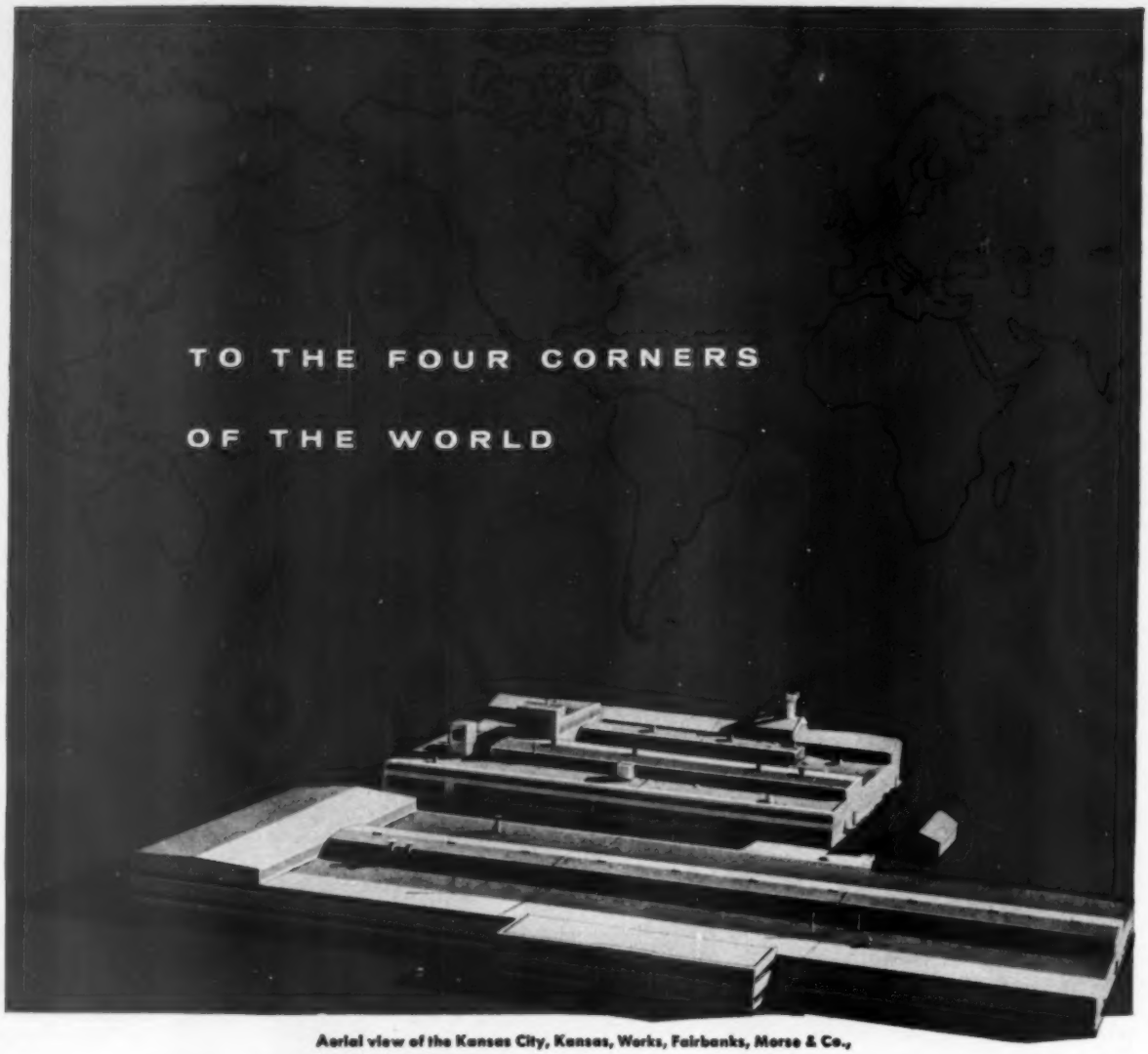


Aerial view of the Kansas City, Kansas, Works, Fairbanks, Morse & Co., 3601 Kansas Avenue.

...from Kansas City

Yes, from our new, modern-as-tomorrow works at Kansas City, we serve the world's needs for pumps.

As a major supplier of quality pumping equipment, it is particularly suitable that this new Fairbanks-Morse plant be located at an important crossroads of the world . . . Kansas City. In this new plant 190,000 square feet of manufacturing space and a complete foundry occupying 150,000 square feet are devoted to bringing better service to our customers all over the world.

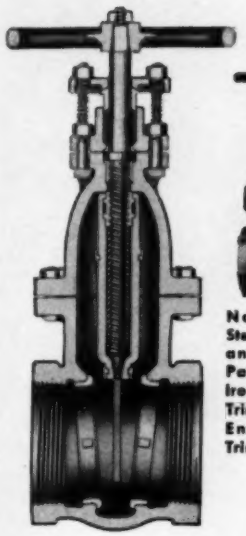
Modern manufacturing, development and testing equipment backed by engineering and production skills of highly trained personnel combine to produce products of unmatched quality . . . in performance, durability, economy. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

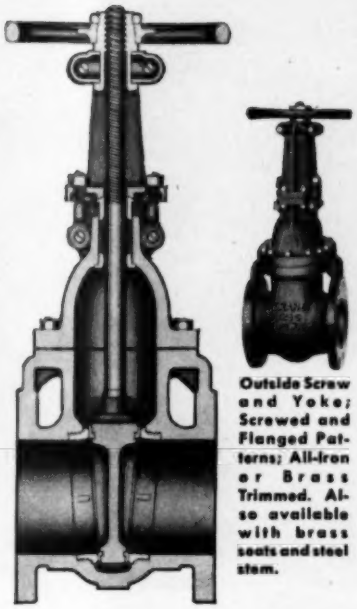
a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

Crane 125-Pound Iron Body Wedge Gate Valves are an improved design, embodying many features of unusual merit. They set a new peak for quality in iron body wedge gate valves, having greater strength, longer life, and better all-round adaptability for all types of services.



Non-Rising Stem; Screwed and Flanged Patterns; All-Iron or Brass Trimmed. Hub Ends, Brass Trimmed only.



Outside Screw and Yoke; Screwed and Flanged Patterns; All-iron or Brass Trimmed. Also available with brass seats and steel stem.

See If You Don't Agree!

Here's the big value—the big selection: CRANE 125-Pound Iron Body Wedge Gates

. . . with quality features that assure exactly the kind of service you want. Body and bonnet are oval-shaped with extra metal where it's needed most, to provide liberal strength. Flanged patterns have tie-ribs between body and bonnet flanges. You also get a solid web-type disc with long guides . . . a stem of liberal diameter with long thread engagement . . . an exceptionally deep stuffing box with high-grade packing . . . a two-piece ball-type gland and flange—plus an easy-to-grip handwheel with oval-shaped rim. Non-rising stem valves have a brass bushed stem collar. OS&Y design includes a brass bonnet bushing, swinging eye bolts . . . and a tee-head disc-stem connection on sizes 12-inch and smaller.

Big selection includes all-iron or brass trimmed valves . . . Underwriters' pattern valves, quick-opening types . . . valves for process industries . . . valves for marine service. Sizes up to 48-inch. Check your Crane Catalog or ask your Crane Representative next time he calls.

THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

MAMARONECK, N.Y.

Photo by Fairchild Aerial Surveys

CONVERTS 4 FILTERS TO POROUS UNDERDRAINS

Westchester Joint Waterworks #1, serving the Village of Mamaroneck, N. Y., and the Towns of Harrison and Mamaroneck, has four 18′ x 24′ beds, each with a capacity of 1¼ MGD. All were originally built with conventional graded gravel, and pipe laterals with strainers. All have had the usual troubles of mudball formations . . . upset beds . . . loss of filter media . . . corroded strainers . . . and other complications inherent with this system.

However, a gradual modernization program over a period of years, has all but eliminated these problems. Two of these filters have already been converted to our ALOXITE® aluminum oxide plates. Another one is now in the process of being modernized. And the last filter will be changed over to porous underdrains later this year. (Incidentally, the first of these jobs was our seventh installation, and today there are well over 300 in service).

The results, as usual, have been uniformly good. There are no mudballs, and no upset beds. Backwash is complete over the entire bed. And there is no building up of head loss in the system. Superintendent G. H. Straub reports that it is easy to keep filter media clean. Also, that the efficiency of these underdrains has kept operating costs low.

CARBORUNDUM

Registered Trade Mark

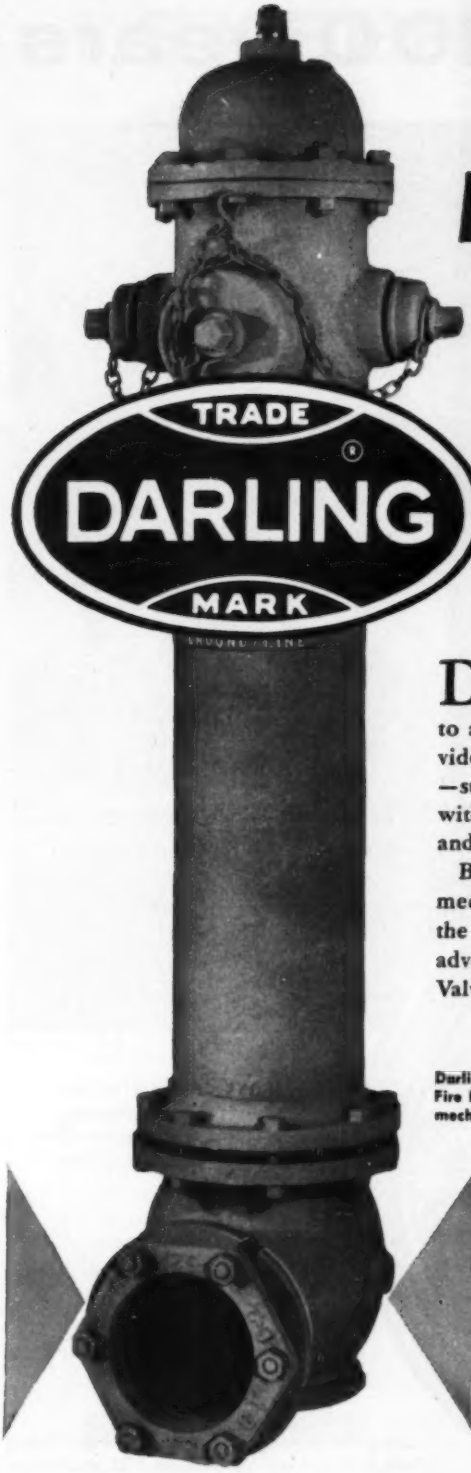
Dept. M-84, Refractories Division The Carborundum Co., Perth Amboy, N. J.

Send for our booklet on porous media. All fields of filtration and diffusion covered in 56 pages. No obligation, of course.

MECHANICAL JOINTS

...another plus feature available with

DARLING VALVES AND HYDRANTS



DARLING mechanical joint valves and hydrants are built to approved standards and provide all the recognized advantages —such as simple, fast installation with no special skills required . . . and assurance of tight joints.

But whether or not you require mechanical joints, don't forget the outstanding *performance* advantages that only Darling Valves and Hydrants can give you. For example, there's Darling's revolutionary B-50-B packless dry-top hydrant development with its ball-bearing operation and "O" ring seals. And in gate valves, Darling's fully revolving double disc, parallel seat principle . . . for long life, low maintenance and unmatched operating ease.

Be sure to get *all* the facts. Complete information is yours for the asking.

Darling B-50-B Fire Hydrant with mechanical joint.

Darling Revolving Disc Gate Valve with mechanical joints.

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

With 100 years

Ewing Galloway

This is New York, as seen from East River, showing Empire State, Chrysler and United Nations buildings.

Bettmann Archive

Old print showing cast iron water mains being installed in New York about 100 years ago.

MODERNIZED cast iron

of EXPERIENCE...
they must be right

NEW YORK installed cast iron water mains 100 years ago... and installs them today!

One hundred years ago, New York was a city of about 750,000 population, served by 237 miles of water mains. Today's eight million population requires 5500 miles of mains, of which 98% are cast iron. Some of these mains are still functioning after a century and more of service. From 90 M.G.D. a century ago, capacity has grown to 1500 M.G.D.

A customer who buys your product year after year—generation after generation—is a "jewel beyond price". Be you merchant or manufacturer, you might count such customers on the fingers of your two hands. Yet, the cast iron pressure pipe industry can count more than 60 of them—utilities that have been buying cast iron pipe for water or gas mains (or both) for 100 years.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

CAST Q® IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

In good condition after 100 years of service, this cast iron distribution main is one of several still functioning in New York City.

pipe FOR MODERN WATER WORKS OPERATION

If you're interested in water works,

...let us send you a copy of this booklet which tells how new Ring-Tite Coupling cuts costs

WHETHER you're engineer, contractor or water works official, whether you're responsible for selection, installation or operation of water lines, here is a booklet that can show you the way to save money. It tells about the many outstanding features of the new Ring-Tite® Coupling; how water line assembly time is saved every step of the way; how it saves at valves, hydrants and fittings; how it pairs up with Transite® Pressure Pipe, the asbestos-cement product, that has set the pace for performance in water line service.

Get your copy today . . . write for Brochure TR-142A, Johns-Manville, Box 60, New York 16, N. Y.

JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

WITH NEW RING-TITE COUPLING

Proud "city fathers" must look to the future, too!

IOWA hydrants and valves are never "orphans"!

No need to worry about the future of your city's water system when you choose *Iowa*. You know you're buying a reliable product from a reliable firm and that there will always be replacement parts, when and as needed. What you may not know, though, is this . . . *Iowa* hydrants are easily and economically serviced—even by new employees without special training.

Below are additional facts to keep in mind when you plan to expand or replace any part of your city water works.

IOWA HYDRANTS

Provide full, truly unrestricted water way.

Open *with* the pressure for faster water delivery.

Close *against* the pressure to eliminate water hammer, provide flushing action.

Assure positive drainage.

Are available for any type of connection.

All working parts removable through top—no digging or special tools required.

Meet all A.W.W.A. specifications.

IOWA GATE VALVES

Double disc, parallel seat.

Positive wedging action for efficient, no-leak closing.

Gates hung loosely from stem nut—no binding.

Rugged, time-proved design means long life, low service costs.

Available with bell, flange, or mechanical joint connections to fit any existing or planned installation.

Meet all A.W.W.A. specifications.

The best insurance policy is the order that specifies IOWA!

IOWA VALVE COMPANY
A Subsidiary of James B. Clow & Sons
201-299 NORTH TALMAN AVENUE
CHICAGO 80, ILLINOIS

Don't let CORROSION put the bite on *your* Sewage Plant this year

PROTECT WITH PITT CHEM!

Don't underestimate sewage corrosion! It's a silent, insidious destroyer, on duty three shifts a day. It takes a tough, heavy film of protective material to give you sure, long-lasting protection against it. Sewage engineers all over the country are specifying *Pitt Chem* Tar Base Coating for the job. *Pitt Chem* is easy to apply, protects metal, masonry and concrete from sewage 7 to 10 years longer than ordinary paint, and its cost fits even the most nominal maintenance budget.

A *Pitt Chem* engineer will be glad to show you how you can protect your investment in sewage plant equipment . . . at a small fraction of the equipment's cost. Why not call for an obligation-free *Pitt Chem* survey today.

W&D 4996

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

PROTECTIVE COATINGS DIVISION

PITTSBURGH
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Grant Building, Pittsburgh 19, Pa.

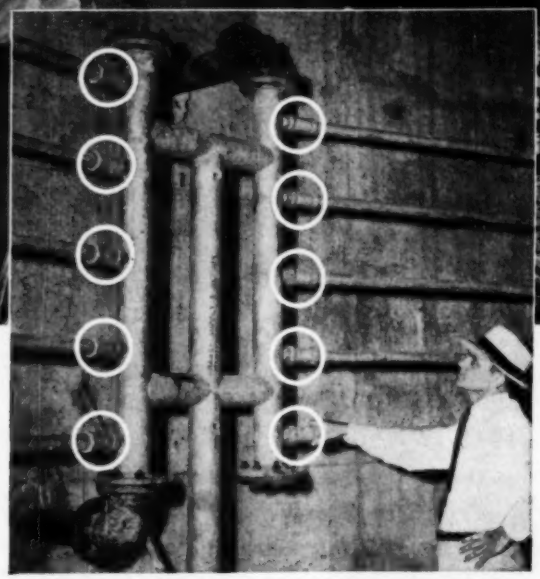
COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

Canton sanitary engineers find the easiest way to solve difficult piping problems is also the most dependable . . . with Dresser Couplings

One of the construction problems at Canton, Ohio's Sewage Treatment Plant was installation of a special welded tee on the effluent line between grid house and primary tanks.

The use of 54" Style 38 Dresser Couplings made the installation relatively simple. Workmen, with a minimum of skill and heavy equipment, quickly made permanently tight Dresser joints.

Recognizing the many applications for versatile Dresser Couplings throughout the plant, Canton engineers greatly simplified tough, close-quarter piping installations.



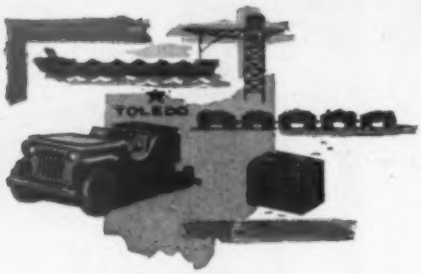
Hot water heating coils completely encircle the interior walls of six large digester tanks in the Canton Plant. 450 Dresser Style 65 Compression Couplings were used to absorb expansion-contraction of piping and to simplify close-wall installation.

Write today for more information on how Dresser Couplings can save *you* time and money on water, sewage and industrial waste projects.

DRESSER® COUPLINGS

Dresser Manufacturing Division, 69 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ont.

Toledo Prefers Concrete Pressure Pipe



Toledo engineers prefer concrete pressure pipe for the city's water supply mains. In 1948 an 8,600-foot installation, known as the Bancroft Street Crosstown Main, was completed. Since then 24", 36", 48" and 72" concrete pressure pipe has been used in major additions to the city's water supply system. Just recently contracts have been signed by Lucas County authorities and work is in progress on additional projects in the Toledo area, involving 16" and 24" pipe.

There are a number of reasons for Toledo's increasing use of concrete pressure pipe. Sustained high-carrying capacity and long life are two of the most important. Another is low maintenance cost. The original cost is also low and installation is accomplished quickly and easily.

Talk to Toledo engineers when you plan your next water line. You'll learn why they like concrete pressure pipe—not only for transmission lines, but for city distribution mains as well.

Member companies manufacture concrete pressure pipe in accordance with nationally recognized specifications

Concrete PRESSURE Pipe

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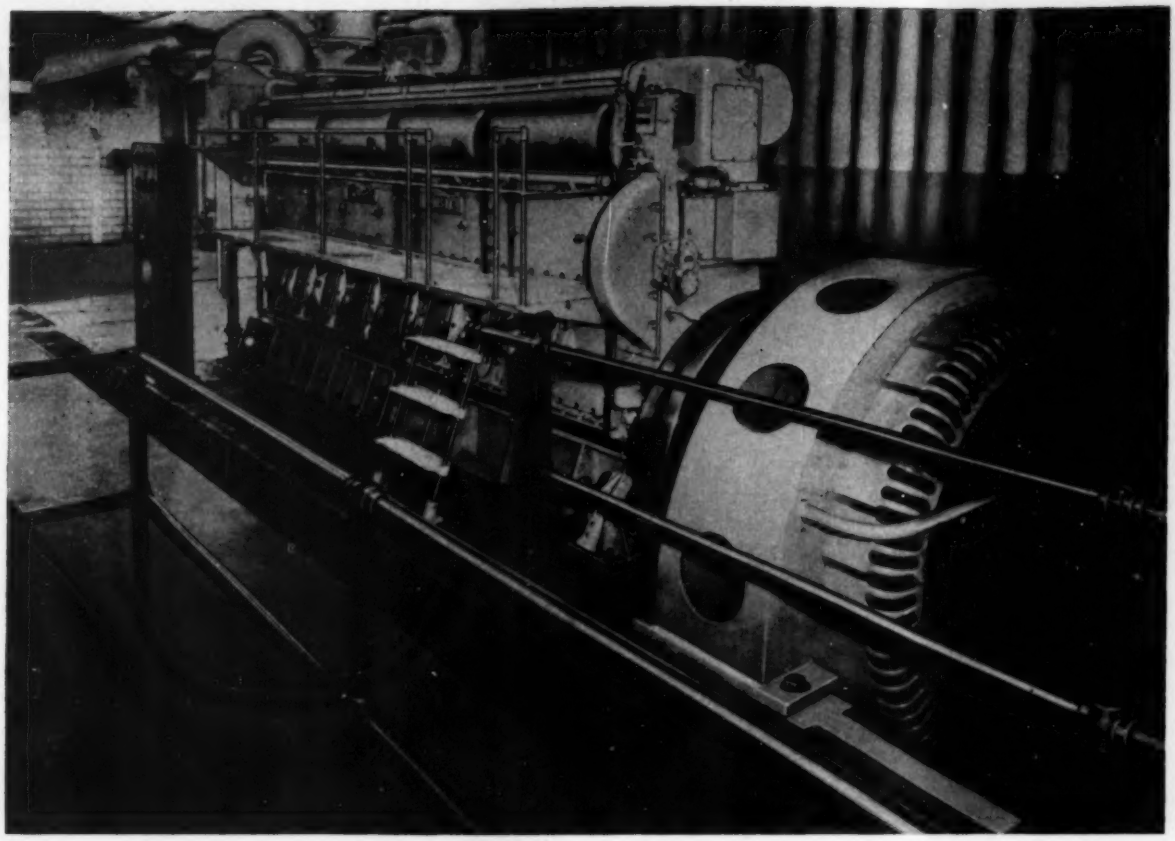
WATER FOR GENERATIONS TO COME



Not yet "broken in"... but producing over 14 K.W.H. per gallon!

That's the report on this new Superior Model 65 Diesel recently installed in the Petoskey, Michigan, power plant. This record of high level performance at low operating costs—even under widely oscillating load—is typical of the Model 65.

Designed to pack more horsepower into less weight and space, this Superior Model 65 keeps building and installation costs down. You'll find that fuel costs are low, too, especially when it's equipped for dual-fuel operation. By simply pushing a button, you can switch between diesel and sewage (or other by-product) gas.

There's long life in the structure of the Model 65, too. From its heavy-duty, welded steel block to its alloy iron cylinder heads and advanced fuel system, you'll find only the finest in materials and craftsmanship—the quality that only its maker's 100 years of engine building experience can provide.

Whether you're interested in diesels for generator, pump, or other drives, you'll want complete facts on the Superior Model 65. Just write or stop in at the nearest office listed below.

IMPORTANT FEATURES OF THE SUPERIOR MODEL 65

- Fuel economy is a fact with this precision-built 4-cycle heavy-duty engine. Improved combustion and scavenging are two of the reasons.
- Long-lived Superior engines consistently produce lowest overall power cost, by fewer parts replacements and lower maintenance.
- All models can be specified for Dual Fuel operation (by-product gas and diesel fuel oil).
- Maximum accessibility to all operating parts for simple and easy maintenance.
- Available in both 6 & 8 cylinder models, naturally-aspirated or supercharged.
- Size to fit any need from 420 to 1250 KW, or 580 to 1765 BHP.

DIESEL DUAL FUEL GAS — ATLAS — Superior DIESEL ENGINES — DISTRIBUTOR OF Lister DIESELS IN U.S.A.

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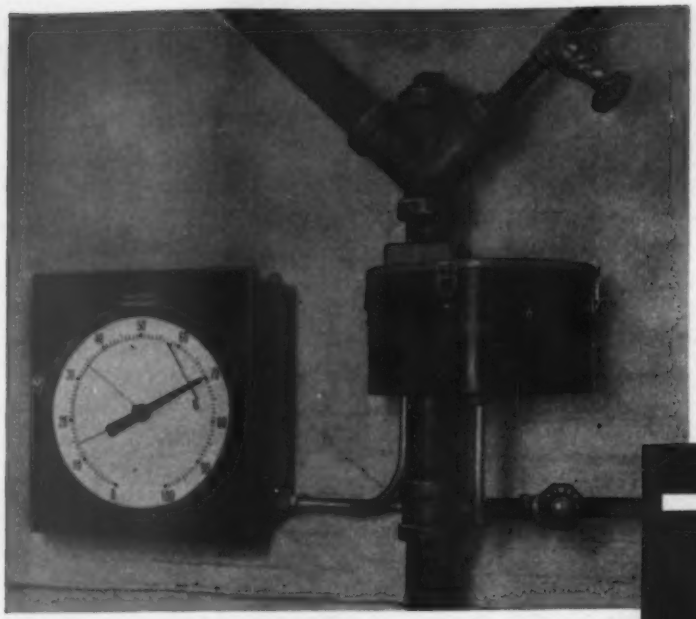
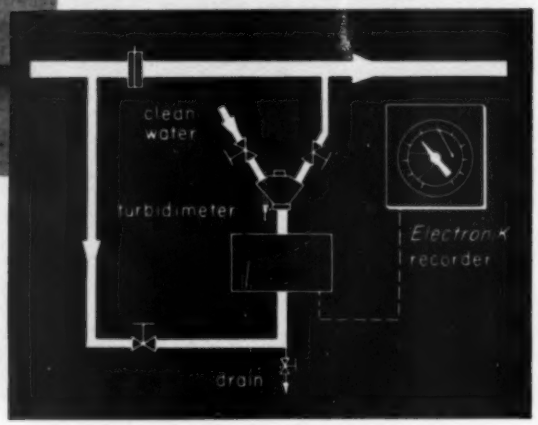


General Electric Recording Turbidimeter includes sampling unit (at right) and ElectroniK recorder. Diagram shows how a typical installation is connected to sample from a main line.



Here's the accurate, automatic way to measure turbidity

THE GENERAL ELECTRIC *Turbidimeter* fills a long-felt need for an automatic means of measuring the turbidity of liquids. Incorporating design features that assure consistent, reproducible results, this instrument eliminates the time, trouble and uncertainty of intermittent laboratory tests.

A specially designed sampling chamber and photocell circuit continuously measure the amount of suspended solids. To provide a continuous, permanent record of turbidity values, the system utilizes an *ElectroniK* recorder . . . which can be located at any distance from the *Turbidimeter*. The whole system is unaffected by fluctuations in line voltage or aging of the photocell . . . can be field calibrated for any range from 0-25 to 0-10,000 ppm. Over-all accuracy is ±5 per cent of full scale.

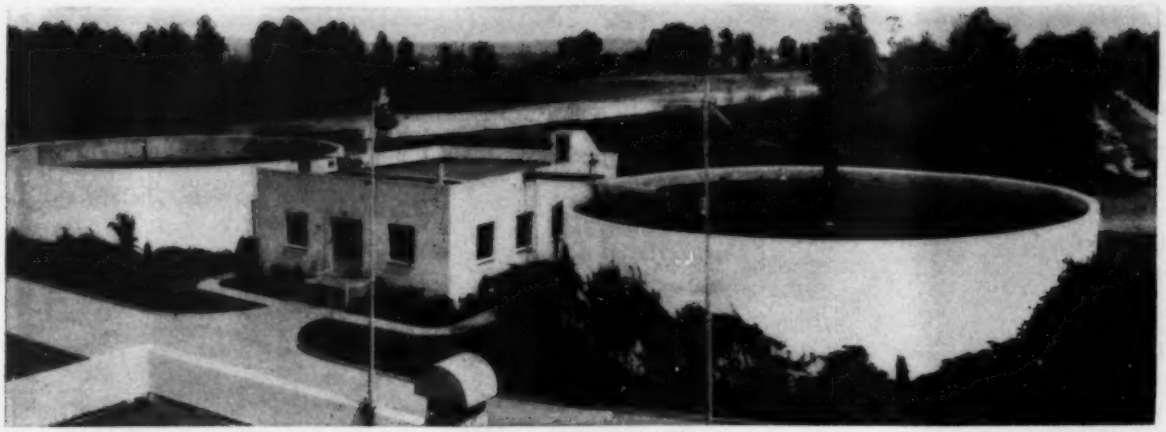
The *Turbidimeter* gives water, sewage and industrial waste treatment plants a precise method of continuously monitoring plant effluent . . . for evaluating surface water supplies . . . for adjusting feeding rates of coagulant and other filter aids . . . for scheduling backwashing, cleaning or diverting operations . . . and for evaluating the performance of treatment processes.

Contact the nearest General Electric office for further information. And for specialized assistance on treatment plant instrumentation, call your nearby Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● REFERENCE DATA: Write for Data Sheet No. 10.14-5a, "Continuous Turbidity Measurements."

MINNEAPOLIS **Honeywell**
BROWN INSTRUMENTS
First in Controls



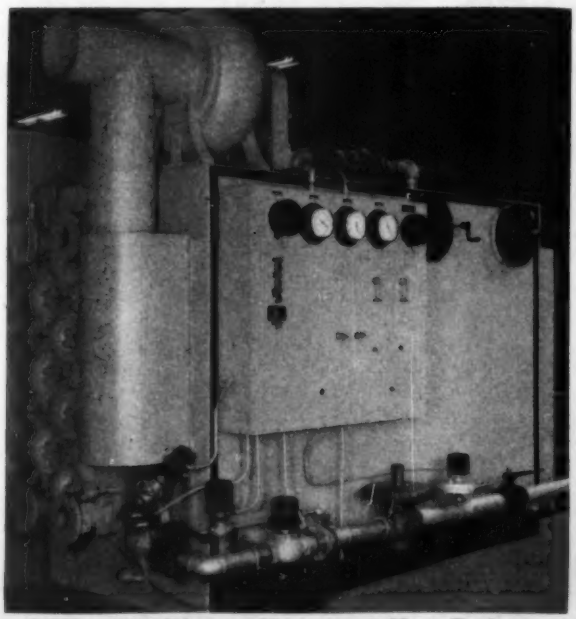
At Tacoma, Washington . . .

This Gleaming New Plant is Run at Peak Efficiency

WITH MODERN PFT EQUIPMENT

Sparkling clean and beautifully landscaped, Tacoma's new primary sewage treatment plant is a model of modern treatment methods and efficient operation. Completed in 1952, it uses PFT equipment for *effective treatment* and *more convenient operation.*

For the digestion tank, a *PFT 75' Floating Cover* was installed for positive scum submergence and more flexible capacity (the cover simply rises or lowers with additions and withdrawals). The snug fitting cover eliminates odor and fly nuisance, and explosion hazards are reduced because gas collected under the cover is maintained at positive pressure under all operating conditions.



PFT #1000 Digester Heater and Heat Exchanger

For added convenience, a *PFT Cover Position Indicator* in the Control Building tells the operator at a glance the position of the cover.

A *PFT Heater and Heat Exchanger* unit automatically provides building heat and maintains close temperature control of the digester. Fired by gas *or* oil, it cuts fuel costs substantially by utilizing all gas produced in the digester. Tacoma's efficient digester operation is largely due to this close, automatic heat control!

Other PFT equipment in the new plant includes the following Gas Safety equipment—Heater Flame Trap; Pressure Relief Waste Gas Flame Trap; Waste Gas Burner; Pilot Line Flame Cell; Drip Traps.

The Tacoma plant's success results from close cooperation among three key men—C. S. Seabrook, Sanitary Engineer; Louis E. Fox, City Engineering Department; and Lyman Ketcham, Chief Operator.

Design / Engineering Office
of plant by / of Clyde C. Kennedy

P.F.T.

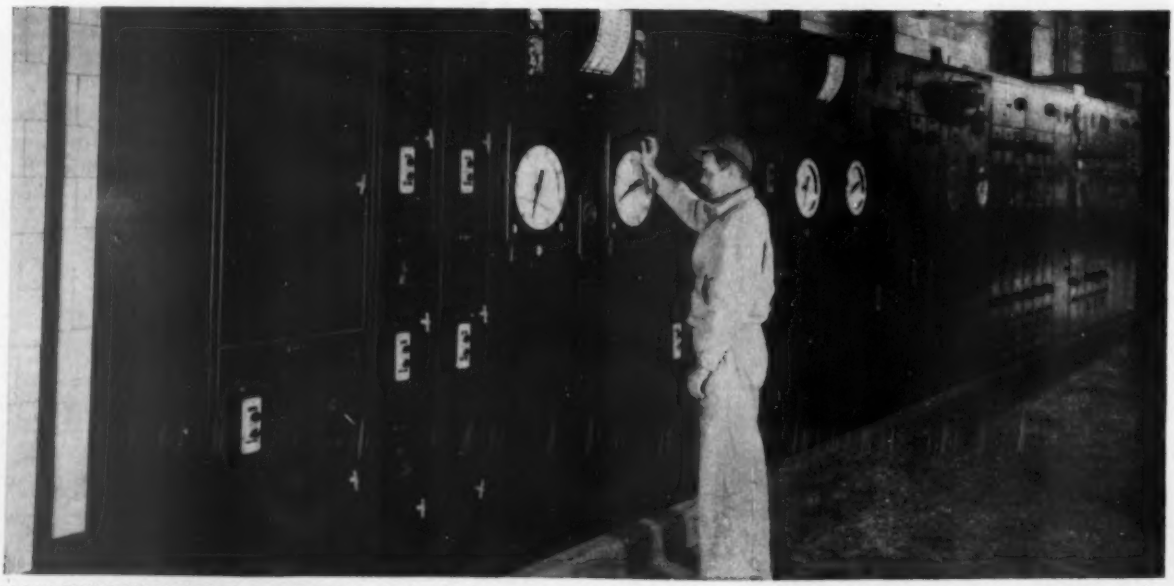
waste treatment equipment
exclusively since 1893

PACIFIC FLUSH TANK CO.
4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C. • JACKSONVILLE • DENVER

AERIAL VIEW of Baltimore treatment plant shows layout of settling tanks and filters. The plant, serving the Baltimore area, handles an average of 130 mgd. Architect was Lucius R. White; general contractor was the Chesapeake Contractors.

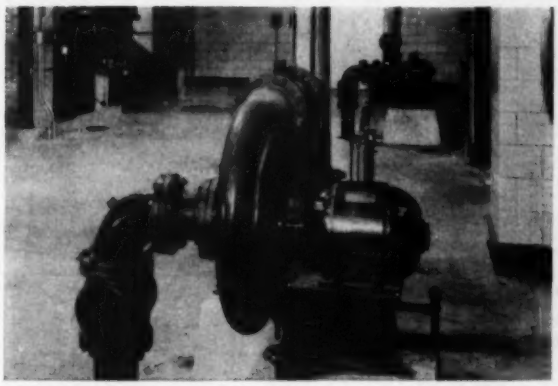
Baltimore's modernized sewage plant



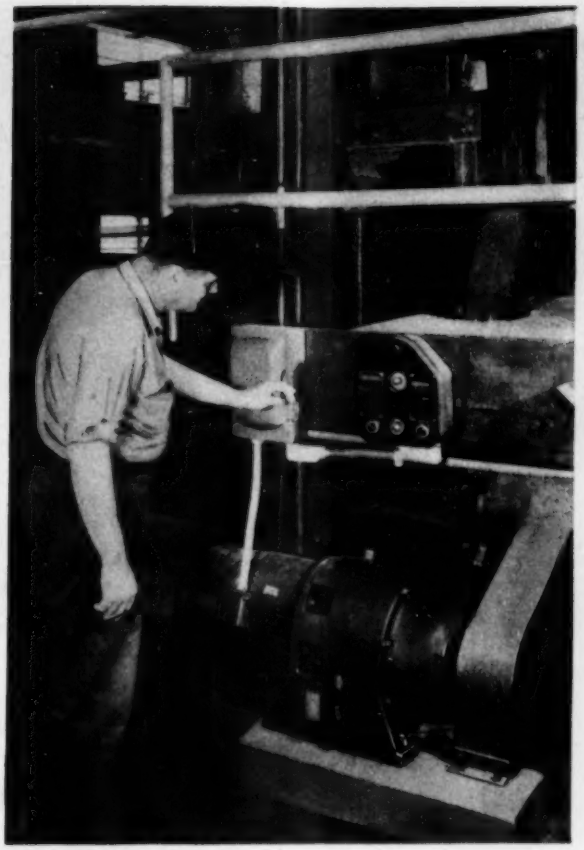
MAIN PROCESS CONTROL panel for the sludge-drying plant is this G-E Cabinetrol* panel. G-E Apparatus Sales engineers helped to plan installation to fit the exact needs of the plant.

*Reg. trade-mark of General Electric Co.

VAPOR FAN, driven by 60-hp G-E motor, removes moist air from cyclone and discharges it into the furnace for drying.



GAS BOOSTER, driven by G-E 7½-hp motor, increases pressure of gas coming from digester tanks for plant utilization.



EFFICIENT DRIVE for the mixer is supplied by this economical, easily maintained 15-hp G-E gear-motor.

brings CLEAN WATERS to Back River

G-E equipped sewage treatment plant expansion completes sludge-drying project for the city

In January, 1953, Baltimore's newly modernized drying plant went into full operation. Owned and operated by the city of Baltimore, it was built to safely handle the city's waste and to help decontaminate the Back River, making it safe for recreation. This one plant handles the major part of the entire Baltimore area.

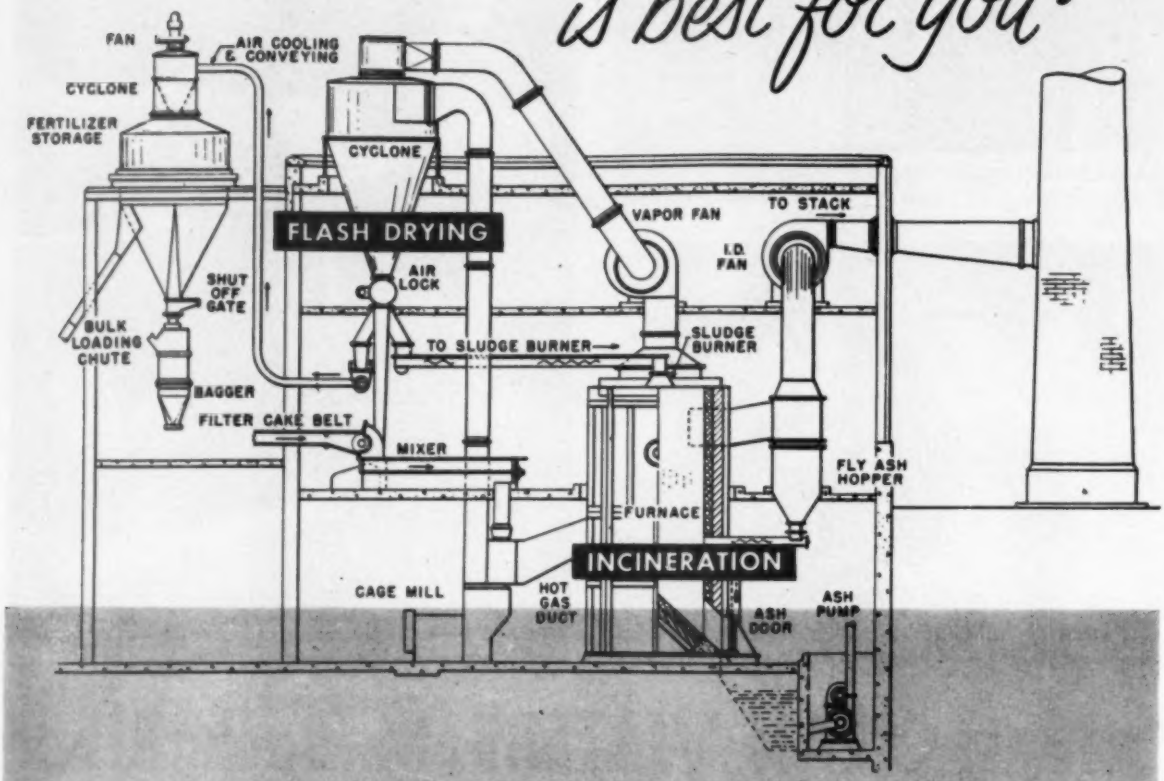
Consulting engineers Whitman, Requardt & Associates and electrical contractor Blumenthal Kahn Electric Co. utilized G-E application engineering aid in specifying and installing the G-E Cabinetrol panel, which controls power distribution of low-voltage power for the drying plant.

SPECIALISTS IN SEWAGE-PLANT ELECTRIFICATION, G-E application engineers are ready to work with *your* engineers and consultants and contractors to help design a co-ordinated electrical system for your new plant or modernization project. Contact your local G-E Apparatus Sales Representative early in the planning stage. And to gain public support for your new sewage facilities, ask him now how you can put the G-E "More Power to America" film, CLEAN WATERS, to work in your community. General Electric Co., Schenectady 5, N. Y. 566-81

Engineered Electrical Systems for Sewage Plants

GENERAL ELECTRIC

Which **SLUDGE DISPOSAL SYSTEM** *is best for you?*



Only the C-E Raymond System of Flash Drying & Incineration offers the proved, practical flexibility which permits *either* flash drying sewage sludge to a marketable fertilizer . . . or incinerating it to a sterile ash—in any proportion and under complete control. In either case, too, high temperature deodorization of stack gases may be included if you wish.

This flexibility of the C-E Raymond System is an important reason why it is the most widely used heat method of sewage sludge disposal. In fact, the total daily capacity of C-E Raymond Systems installed, under construction or on order is *nearly 50% more than all other heat methods combined.*

Furthermore, the C-E Raymond System has been proved in service in communities of every size—ranging in equivalent population from 6,000 to 3,600,000—and located in every section of the country, coast to coast.

So, whatever your particular requirements, look to the leader for help in selecting the proper equipment. The services of a qualified engineer are freely available to you or your consultants. B-755

COMBUSTION ENGINEERING

RAYMOND DIVISION

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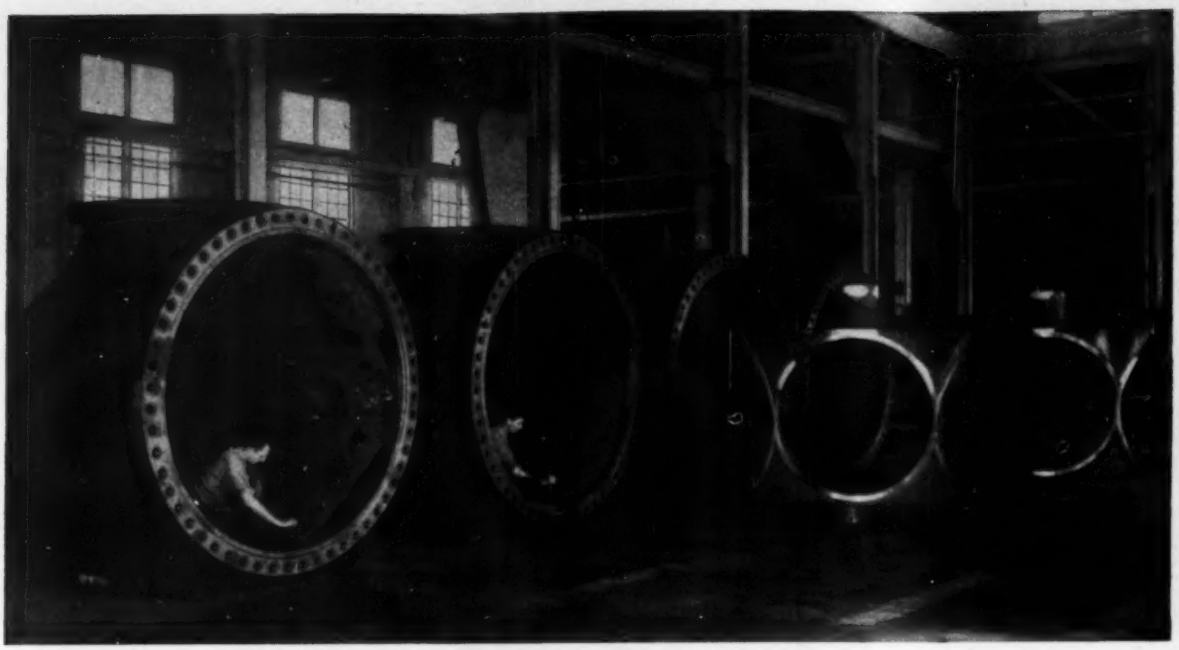
ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL



View of four bodies of 54" ROTOVALVES with two plugs in the background. These valves are part of a large order under construction for the City of New York, Board of Water Supply, Delaware Aqueduct Project.

A Very Real Contribution to Water Works Development!

The ROTOVALVE answers the ever increasing need in the waterworks field for a valve which couples ease of operation with positive performance under both normal and emergency conditions. For these reasons it was selected for both shut-off and throttling services on this important project.

S. MORGAN SMITH Co.

YORK, PENNA. U.S.A.

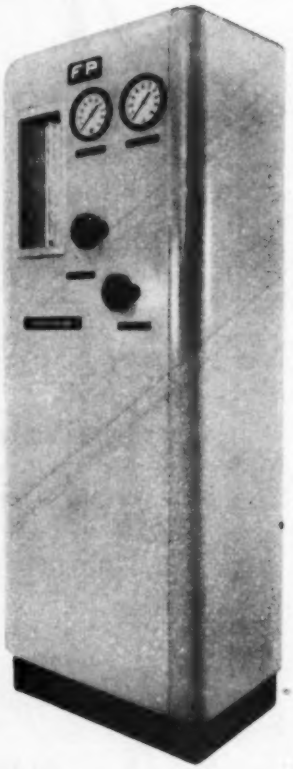
how much does it cost to run the old model?

Even if you bought new today one of the old model chlorinators, you can actually scrap it right now and save money!

How can such a thing be?

In hundreds of installations using F & P Chlorinators it has been proven conclusively that costs of operation and servicing are so much lower than old style chlorinators that it actually *costs money* right from the first day of operation to have an old style chlorinator.

Fischer & Porter designed this new chlorinator right from the floor up. New materials are used throughout to make it impervious to corrosion. Encased in a fibre-glass cabinet, the new F & P Chlorinator handles chlorine —in fully enclosed, tightly sealed, corrosion resistant pipes and components. It is the best, safest, most efficient, easiest operating chlorinator ever devised.



Right from the purchase price you save money on an F & P Chlorinator. And you save money every day thereafter, because you have less maintenance cost, less chance of breakdown with sky-high service charges, no need for multiple reserve units or scores of spare parts, no wasted chlorine gas lost through water seals.

As a top municipal official, as an ethical consultant, as a practical operating man—you must admit if all these things we say are true, you can't afford to ignore this new chlorinator.

It won't cost you a single penny to *get the facts* about the F & P Chlorinator. It will obligate you in no way. Why not write today?

FP

T.M., F&P CO.

complete process instrumentation

FISCHER & PORTER CO.

5481 Fischer Road, Hatboro, Pa.

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18 YEARS EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

A Service

that knows no boundaries

From Alaska to Zamboanga and points North, East, South and West, wherever man has a need for water—there you will find Layne.

It's a typical American success story—this history that spans nearly three quarters of a century and started with a one man muscle power drilling rig—and an idea.

Today Layne is the name of a product—but it's more than that—much more. The name Layne is also the name of a service, international in scope, that includes every phase of ground water development from preliminary exploration to maintenance of installed equipment.

Where industry—agriculture—municipality—has any problem that relates to water, there is one organization that offers unbiased authoritative advice—plus the "know how" to solve the problem and keep it solved.

For information on any phase of ground water development, modernization, maintenance or equipment consult your nearest Layne Associate Company—or write

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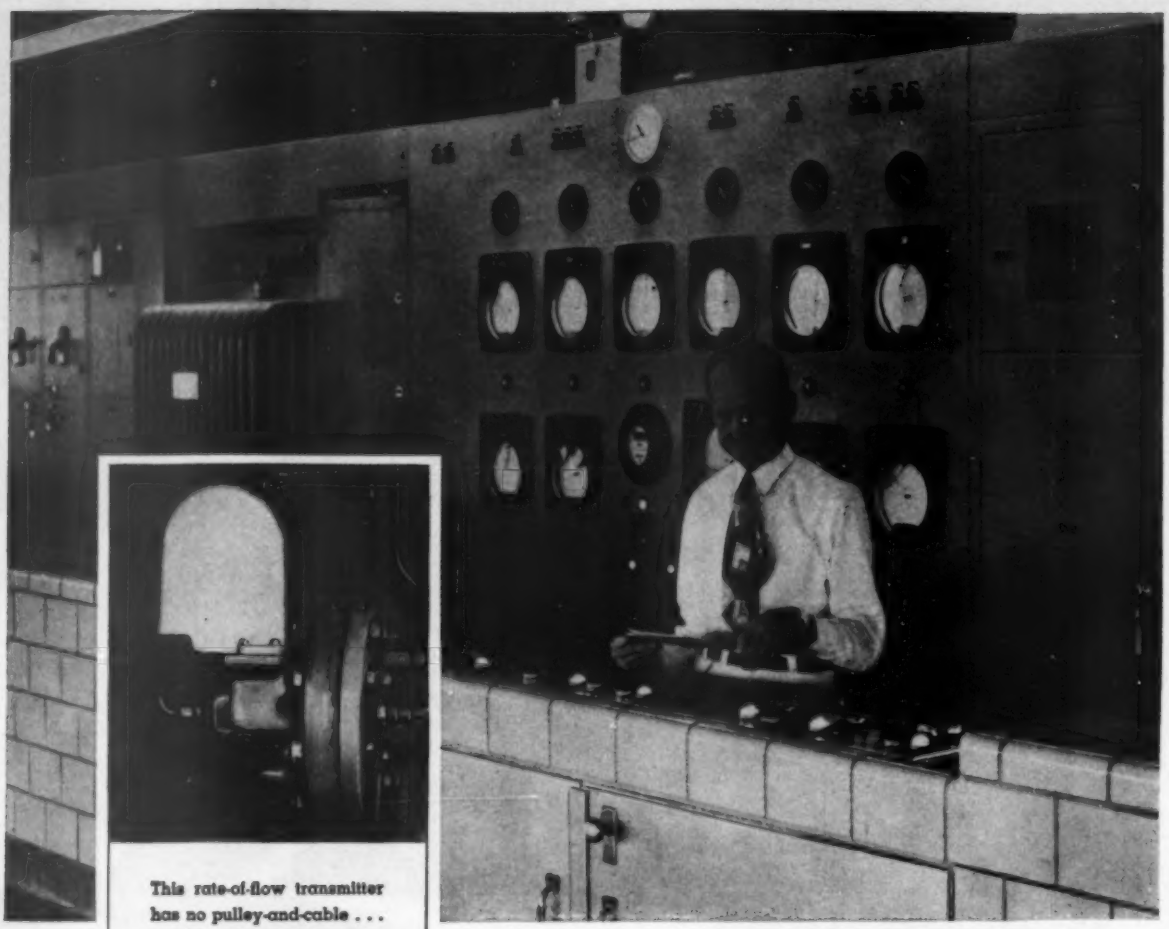
■ An informative booklet "Bulletin No. 100" will be sent free upon request.

Water Wells • Vertical Turbine Pumps • Water Treatment



This rate-of-flow transmitter has no pulley-and-cable . . . can't be damaged by over-ranging . . . uses no mercury.

At the St. Louis County Water Company's new $1,500,000 filter plant, Hine, Mo., d/p Cell Flow Transmitters tap differential pressure from venturi tubes in effluent lines of 6 filter beds . . . transmit flow measurement to bank of 6 M/40 Controllers shown on panel above. Controllers hold filtration rates at pre-set control points. Other Foxboro instruments on panel indicate loss-of-head and backwash rates.

Smoothest-working "TEAM" you can get to control filter rates

Here's an unbeatable team for filter rate control . . . a Foxboro d/p Cell* Transmitter . . . an M/40 Controller . . . and a butterfly valve. It costs less to install and less to maintain!

The d/p Cell Transmitter has no pulley-and-cable to get out of calibration . . . no mercury. It detects flow pressure differential across its tough metal diaphragm . . . is unaffected by backwash and sand. The Controller maintains flow at exact pre-set flow rates . . . keeps filtration in perfect balance with pre-treatment and delivery. The rubber-lined valve provides both flow control and tight shut-off.

Find out how this reliable combination can cut maintenance costs and step up efficiency in your plant. Write for complete information.

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THE FOXBORO COMPANY, 898 NEPONSET AVE., FOXBORO, MASS., U. S. A.

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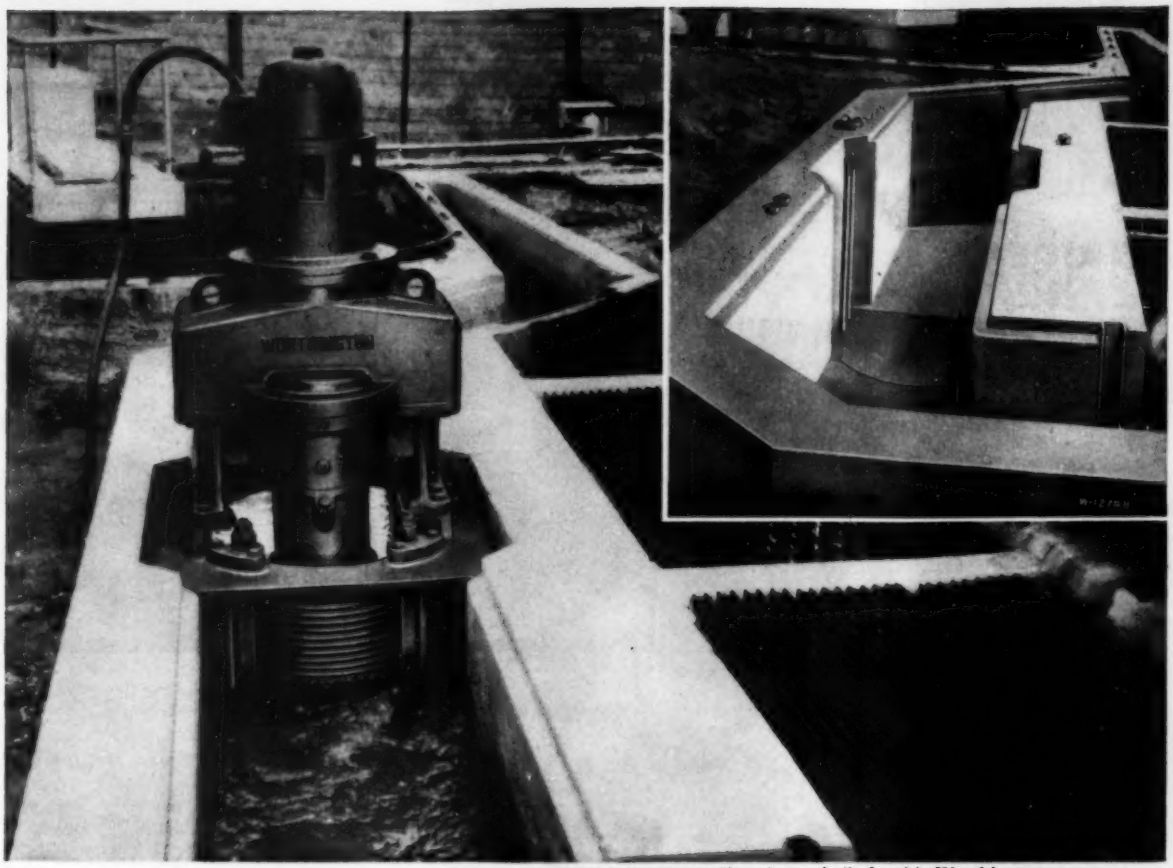
FLOW CONTROL INSTRUMENTATION

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND



SIMPLE SIDE CHANNEL (inset) was built for this Worthington comminutor at Klamath Falls, Oregon, because Mr. E. A. Thomas, the City Engineer, wanted to use the existing channel as a by-pass.

Low installation cost swings Klamath Falls to Worthington

Since the Worthington comminutor is designed so that raw sewage flows straight through its screen, it's easily installed in a straight rectangular sewage channel.

Result? Expensive masonry work is not needed, which makes for simplified, low-cost installation.

This was an important factor in the selection of a Worthington 25C6 comminutor as part of recent improvements at the Klamath Falls, Oregon, Sewage Treatment Plant.

This comminutor, installed downstream from a grit chamber and upstream from a clarifier, was lifted directly from its packing crate and set right in the channel in a minimum of time.

Easy-to-remove cutter racks for occasional sharpening and the built-in flood protection provided by a mercury seal are other advantages of the Worthington comminutor.

Get all the facts and figures on the rugged Worthington comminutor. Check with your nearest Worthington district office. Or write today for new engineering manual on comminutors, W-317-B17. Worthington Corporation, Public Works Division, Harrison, N.J.

W.4.5

WORTHINGTON

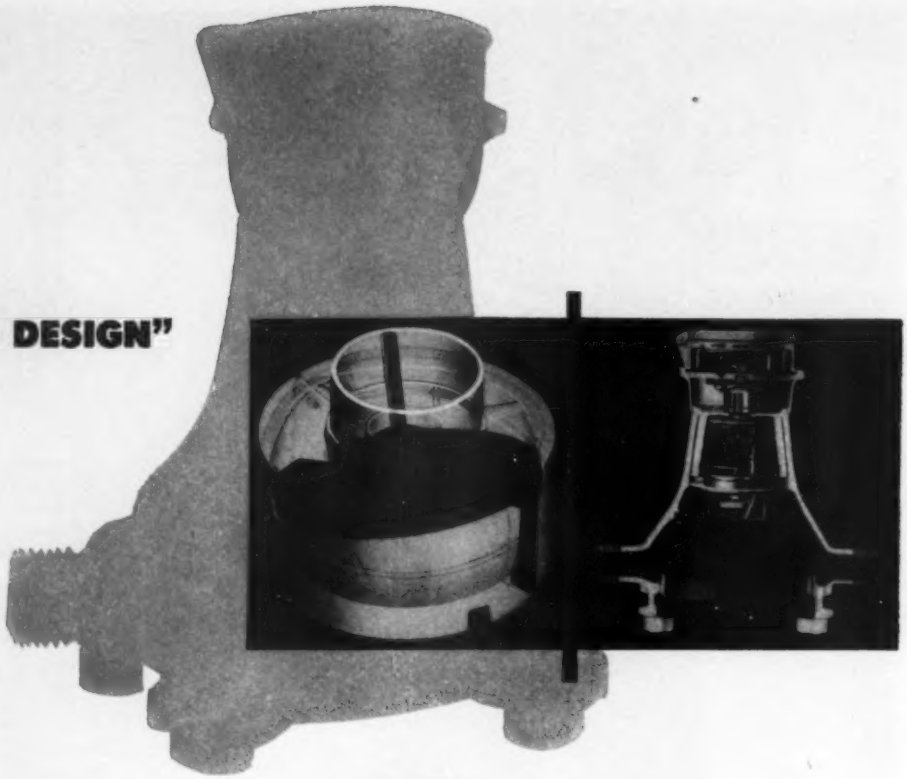
ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

TRIDENT

"BALANCED DESIGN"

MEANS



QUIET, DEPENDABLE OPERATION

Three problems that give meter superintendents gray hairs . . . noisy meters, broken discs and premature failures . . . have as their primary causes turbulence, interference, and improper motion of the disc piston. Here's how Trident meter's "balanced design" eliminates these faults:

The Trident disc is axially controlled. The thrust roller . . . a Neptune "first" . . . guides the disc in the exact path necessary for smooth, balanced flow of the water. No sloppy or eccentric motion to cause noise, disc breakage or excessive wear. Inlet and outlet ports, and the casing itself are carefully designed for smooth, uninterrupted flow of water. There is no turbulence caused by water circulation up through the gear train and stuffing box . . . these are permanently lubricated and sealed from the path of the water.

We believe the Trident meter, if properly installed, is the quietest, most dependable meter you can buy. It's one of the many reasons why more Trident meters have been bought in the past 50 years than any other meter.

NEPTUNE METER COMPANY
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WATER & SEWAGE WORKS

VOL. 101, NO. 8 • A Scranton Gillette Publication • AUGUST 1954

Design of Water Distribution Systems for Service in Arctic Regions

Experimental study of a new dual main house service connection

by **WILLIAM B. PAGE,** ***Arctic Health Research Center, U.S.P.H.S., Anchorage, Alaska***

THE interruption of water services, caused by freezing in distribution mains and service pipes, is one of the main problems confronting sanitary engineers in Arctic regions. As stoppages occur principally in the service pipes, special attention should be paid to this part of the system. A possible solution to the problem is to maintain continuous flow of water through the house service pipe.

In order to install water systems that will function in the Arctic and sub-Arctic, it has been customary to adapt the conventional water supply systems as used in the temperate climate zones either by maintaining continuous flow throughout the system, by supplying heat to the water in the system, or by combining the two systems.

There are three general types of these adapted systems now functioning satisfactorily in Alaskan and northern Canadian localities. They are: (1) the utilidor, (2) the dual main recirculating system, and (3) the single main system with waste outlets.

Three Systems in Use to Prevent Freezing

The *utilidor* is a tube or tunnel constructed above or below ground, containing the water main, sewer line, and a steam line which heats the utilidor and the buildings which the utilidor serves. The utilidor is not always heated, and may contain other utilities.

The *dual main system* consists of two water mains laid adjacent to each other and operating at different pressures. The high pressure line carries the supply to the consumer and the low pressure line returns the unused portion to the pumping plant intake. The water is heated, as it is pumped into the high pressure main, whenever the temperature of the water returning through the low pressure main falls below a specified level (such as 36° F.). The low pressure main is generally of smaller capacity than the high pressure main, because the flow which it handles has been reduced by consumption.

The cost of the dual main system is necessarily higher than the conventional system used in temperate climates since an extra main and service pipes are required. Constant pumping is required in order to maintain continuous flow through the mains and service pipes.

The *third type of system* is a variation in the method of operation of a conventional system, wherein continuous flow in the main results from wasting water through open house taps. This method is employed officially in some small towns in interior Canada. It is used also where wasting is not recognized as official practice by the water departments, but where individual consumers frequently leave taps open during periods of extremely cold weather.

A variation for maintaining continuous flow is to use a single main which returns water to the intake of circulating water pumps. Water is kept continuously moving through the main by pumping. With such a system, however, the flow in the house service pipes is not continuous. This disadvantage can be overcome by the use of a dual house service pipe, both ends of which are attached to the water main by means of special fixtures.

The house plumbing connects at the end of the double pipe line. A

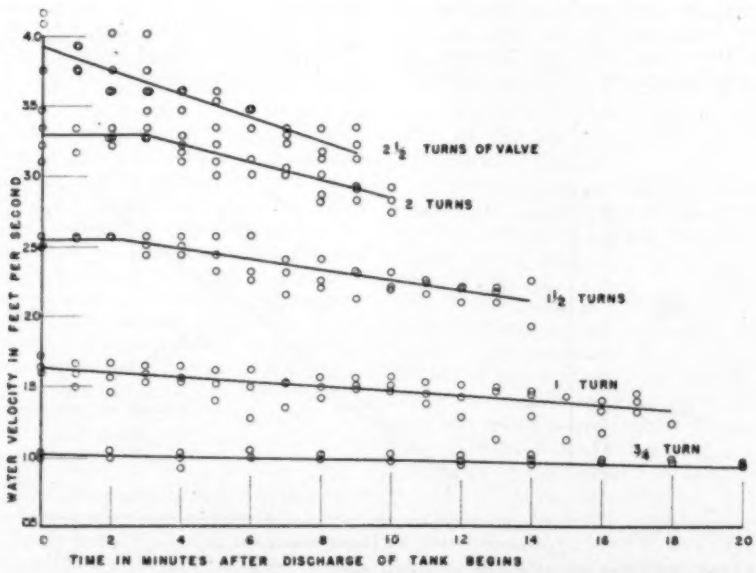

Fig. 1—CALIBRATION CHART for discharge valve of storage tank

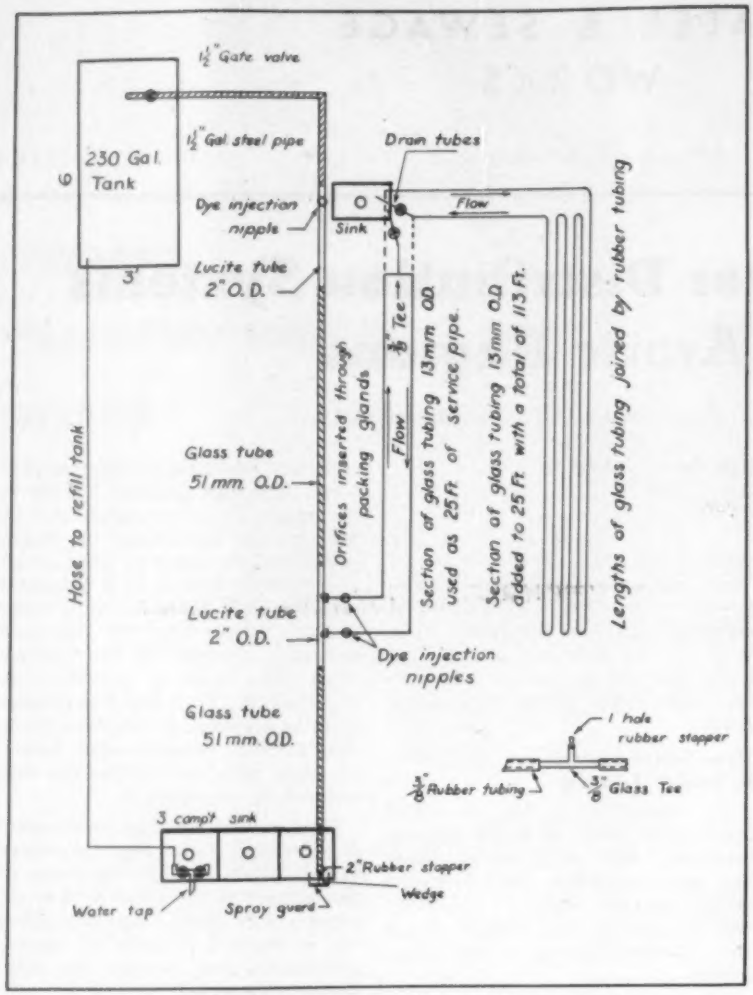

Fig. 4—DIAGRAM of equipment used for velocity measurement

pressure differential is established between the ends of the service pipe (by the action of the water flowing through the main past the orifices connecting the two ends of the service pipe to the main). The difference in pressure causes water to flow through the house service pipe and, as long as the water circulates through the main, a constant movement of water through the service pipe takes place. If sufficient flow is maintained by this method, freezing of the service water pipes can be prevented.

Experimental Study of Design

An attempt was made to determine the feasibility of such a service pipe system by constructing a scale model to permit observations of the relationship between velocities in the main and in the house service pipe. The relationship is important because the success of the system in preventing freezing of the service pipe depends on its ability to maintain an adequate velocity in the service pipe system. Further, if a very large velocity in the main were required to induce the required velocity in the service pipe, the cost of pumping this water through the system would be prohibitive.

Since the device connecting the service pipe to the main (the connecting orifice) determines to a large extent how much flow is diverted from the main line through the service pipe, the design of a satisfactory orifice was a basic factor in this study.

1. The primary objective was to determine whether water circulation could be maintained through a house service pipe, constructed as a loop, and having both ends attached to a single water main by a special fixture or orifice.

2. The second objective was to determine whether the water circulation, if it did exist, would create velocities sufficient to prevent freezing in the service pipes, and whether these velocities could be economically maintained.

3. The third objective was to test the design of orifices for the service pipe connection, which would be efficient and which could be fabricated easily and economically.

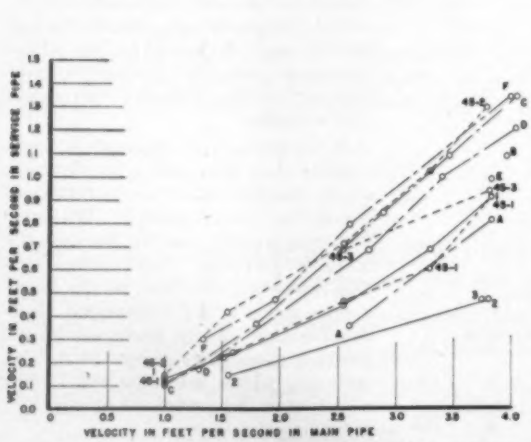

Fig. 2—Approximate values were determined for these orifices.

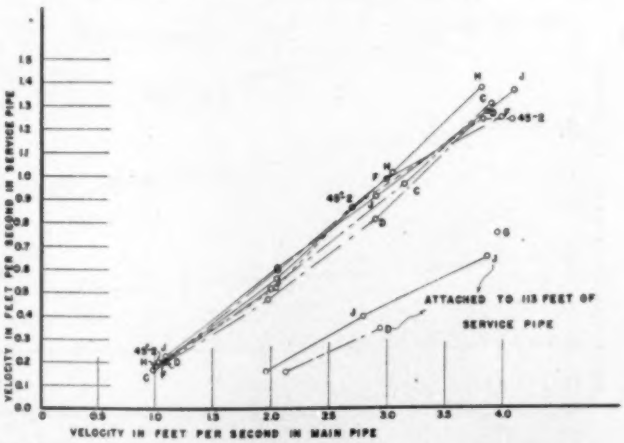

Fig. 3—Tests in this series were controlled more accurately.

COMPARATIVE EFFICIENCIES of orifices of several types

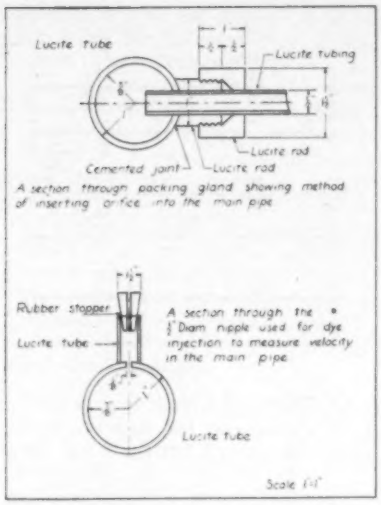
Lucite tube
Lucite tubing
Lucite rod
Cemented joint
Lucite rod
A section through packing gland showing method of inserting orifice into the main pipe
Rubber stopper
Lucite tube
A section through the ° ¼" Diam nipple used for dye injection to measure velocity in the main pipe
Lucite tube
Scale 1=1'

Fig. 5—Orifice construction details

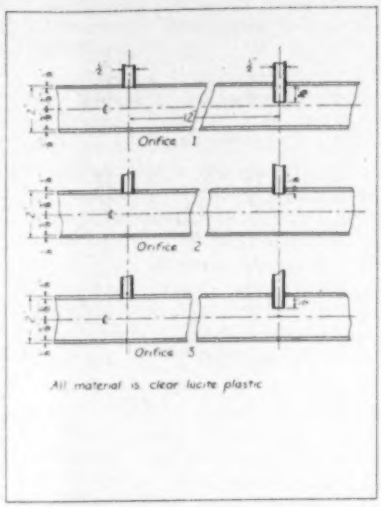

Fig. 6—Orifice sections, types 1, 2 and 3

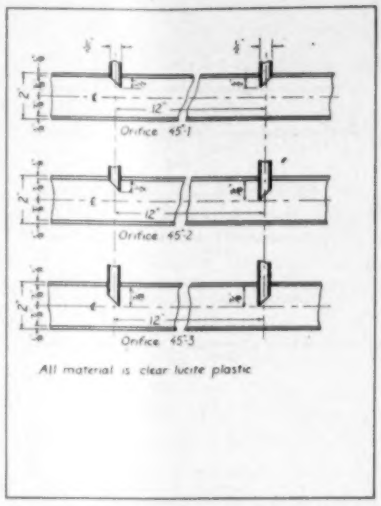

Fig. 7—Orifice sections, types 45°—1, 2, 3

Equipment Used

The equipment used for the study consisted of 1.5-inch diameter galvanized steel pipe for the water main model, ⅜-inch diameter glass tubing for the service pipe model, a sheet metal tank for water storage, a stop watch, and veterinarian's syringe for injection of dye globules for velocity measurement (Fig. 4).

The model water main was constructed of 1.5-inch galvanized steel pipe with an extension of Lucite and glass tubes. The glass tube was used to facilitate velocity measurements with dye globules and a stop watch. The Lucite tube was inserted in the line to permit the installation of the orifices and dye injection nipples. Total length of the model main was 28 feet.

The orifices were made on the ends of six-inch sections of Lucite tubing, which was ⅜-inch in diameter. Insertion of the orifices into the main was accomplished by use of packing glands which were machined from Lucite rods and cemented to the side of the Lucite section of the main (Fig. 5). Since the rate of flow available in the existing plumbing was insufficient to operate the model at the desired rates of flow, it was necessary to use a storage reservoir which permitted intermittent operation of the model. The temperature of the water was uncontrolled, but generally was at tap water temperatures (between 7° and 10° C.).

Experimental Operation

The observations involved a series of simultaneous measurements of the velocity in the model main and service pipes. With the one velocity in the main, a higher velocity will be produced in the service pipe by the more efficient nozzle. The operating procedure included four steps:

1. The velocity of flow in the model main was correlated with various settings of the discharge valve of the storage tank (Fig. 1).

2. Several types of orifices were studied for comparative efficiency, using approximate values of velocity in the model main as determined in step 1 (Fig. 2).

3. The orifices which appeared to have the best possibilities, as indicated by the results of step 2, were compared under more accurately controlled conditions to select an orifice that was efficient and simple to construct. In addition, three new designs, suggested by the results of step 2, were tested (Fig. 3).

4. The length of the model service pipe was increased so that the effect on the velocity of circulation in the service could be observed (Fig. 3).

Table 1

ORIFICE CONSTRUCTION CHARACTERISTICS

Orifice	Description
1, 2, 3,	Straight tubes with square cut ends inserted into the main to selected positions (Fig. 6).
45-1, -2, -3,	Straight tubes with the ends shaped to a 45 degree slant and inserted into the main to selected positions (Fig. 7).
A, B, C,	Straight tubes with the ends shaped to a trough by removal of ⅓ the diameter to varying lengths and inserted in the main to selected positions (Fig. 8).
D, E, F,	Straight tubes with lips formed on the ends and inserted in the main to selected positions (Fig. 9).
G, H, J,	These orifices were shaped after tests were run on the previous twelve. G and H utilize curved surfaces; J is a combination of straight shapes (Fig. 10).

The cost to operate a four-inch main would be as follows:

The intermittent operation of the system, using the storage tank as a source of water, made it difficult to maintain constant velocity over an extended period of time. When the discharge valve was fully opened the storage tank emptied in 10 minutes. The first three minutes of flow gave a nearly uniform velocity of four feet per second. At slower rates of discharge, the period of uniform velocities was longer; at a velocity of one foot per second, it remained practically constant for twenty minutes.

Velocities of flow were determined by the use of immiscible globules stained red with Sudan III and adjusted to the specific gravity of water at 8° C. Benzene and carbon tetrachloride were used to form the globules. The dyed globules were injected into the main or service pipe by means of a veterinary syringe. The time required for the globules to travel through a known length of pipe was measured with a stop watch. The accuracy of this method decreased with an increase in velocity but was considered adequate for the purposes of the study.

The orifices were derived from four basic construction patterns selected for simplicity of fabrication and installation. Table 1 gives a brief description correlated with Figs. 6 to 10.

Orifice Efficiency

The efficiency of the orifices was compared by plotting the relationship between the velocity in the main and the velocity in the service pipe for each individual orifice. Fig. 2 shows the graphs for the first series of velocity measurements made for all orifices. From this comparison chart, four orifices, C, D, F, and 45-2, were

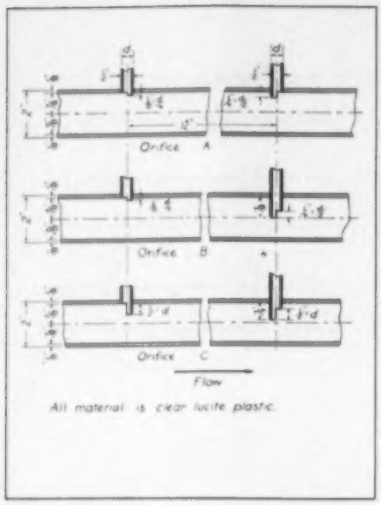

Fig. 8—Orifice sections, types A, B and C

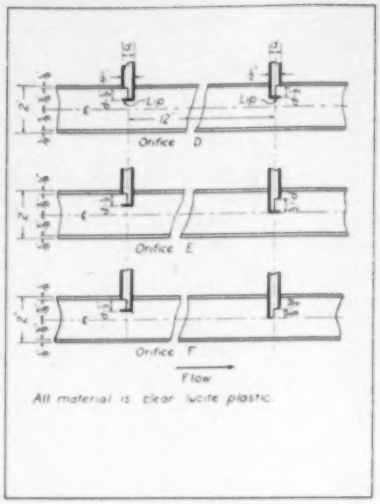

Fig. 9—Orifice sections, types D, E and F

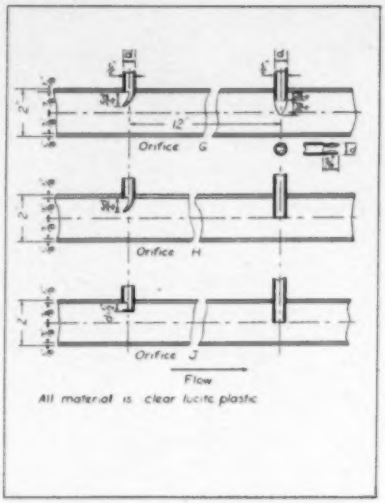

Fig. 10—Orifice sections, types G, H and J

selected for additional study. Orifices G, H, and J were designed after the first observations were made and are, therefore, not included in Fig. 2.

The results of additional observations are plotted in Fig. 3, together with similar observations made on orifices G, H, and J. In addition, Fig. 3 shows the effect of increasing the length of the service pipe. Inasmuch as the first velocity measurements were of an exploratory nature, the accuracy of the measurements of the velocities shown in Fig. 2 is not as high as those in Fig. 3. Data for the most efficient orifices are listed in Table 2.

After the velocity measurements on the various orifices had been completed, the service pipe length was increased from 25 feet to 113 feet. The length of 113 feet was arbitrary and was determined solely by dimensions of the laboratory and available equipment. For use with the extended service pipe, an orifice possessing characteristics representative of the group was desired. Orifice J appeared to be representative of the group (see Fig. 3) and was installed in the main for use with the extended pipe. Orifice D was later installed to determine its behavior with a long service pipe. See Table 3 for operating characteristics of these orifices. Orifice D was considered important because of its construction, the direction of flow in the main having no effect on its operation. This factor was considered for use where the direction of flow in the main is subject to change.

Operating Results

Observations indicate that water flow can be developed in a service pipe which is connected by special fittings (orifices) at both ends to the water main. The house plumbing is attached at the middle of the service pipe and is independent of the service pipe circuit. The flow rate varies with the shape of the orifice fixtures and their position in the main.

Preliminary calculations indicate that a main velocity of 2 ft. per sec. is feasible to maintain and that freezing will be prevented in the service pipes by the velocity of 0.17 ft. per sec. (See analysis of results.)

The connections with an upstream orifice equipped with a lip formation produce the highest velocities in the service pipe. If the lip is shaped into a smooth curve, an increase in efficiency is evident. Comparison of the operation curves in figure 3 and inspection of the orifice shapes as shown in figures 9 and 10 indicate that orifice H is the most efficient. Orifice J gave good results and orifice D is designed so that it will function equally well regardless of the direction of flow in the water main.

Analysis of Results

Velocity in the house service pipe varies with the velocity in the main pipe and with the type of orifice connection used. A velocity of 2 ft. per sec. in the main produces a velocity of 0.17 ft. per sec. in a service pipe and with the type of orifice similar to orifice J is used. A velocity of flow of 2 ft. per sec., in a four-inch pipe requires a discharge of 80

Table 2
ORIFICE OPERATING CHARACTERISTICS
Service Pipe 25 feet long

Orifice	Main Pipe Velocity Ft./Sec.	Service Pipe Velocity Ft./Sec.	Orifice	Main Pipe Velocity Ft./Sec.	Service Pipe Velocity Ft./Sec.
45°-2	4.09	1.23	F	4.00	1.24
	3.83	1.22		3.00	0.96
	2.70	0.86		2.06	0.59
	2.04	0.52		1.19	0.20
			G	3.96	0.75
C	3.90	1.30	H	3.82	1.37
	3.15	0.92		3.05	1.01
	2.00	0.53		2.05	0.56
	0.99	0.17		1.02	0.18
D	3.87	1.27	J	4.10	1.36
	2.91	0.81		2.91	0.91
	1.98	0.47		2.06	0.60
	1.10	0.20		1.10	0.23

Table 3
ORIFICE OPERATING CHARACTERISTICS
Service Pipe 113 feet long

Orifice	Main Pipe Velocity Ft./Sec.	Service Pipe Velocity Ft./Sec.	Orifice	Main Pipe Velocity Ft./Sec.	Service Pipe Velocity Ft./Sec.
J	3.87	0.65	D	2.94	0.34
	2.80	0.39		2.13	0.16
	1.97	0.16			

gpm at a pressure drop of 1.87 lbs. per sq. in. per thousand feet. Maintenance of the same velocity in a six-inch diameter pipe requires a discharge of 175 gpm at a pressure drop of 1.06 lbs. per sq. in. per thousand feet. For a small community, this pumping capacity should be economically possible to maintain. Continuous pumping would be required only during those months in which the ground temperature at the depth of the pipe system is below freezing, estimated to be six months.

Cost Considerations

The cost of pumping to provide the necessary flow for circulatory effect may be computed by the following formula.*

Cost in Cents/1000 Gals. = (Total Dynamic Head in Feet) (Cost per KWH in Cents) divided by (Average overall efficiency in % x 3.185)

Assume the total dynamic head equals 150 feet.

Assume an overall pump and motor efficiency of 70%.

The cost per kilowatt hour can be taken as 7 cents for areas in the vicinity of Fairbanks and Anchorage.

$$\text{Cost in Cents/1000 Gals.} = \frac{150 \times 7}{70 \times 3.185} = 4.72$$

The cost to operate a four-inch main would be as follows:

80 gpm = 115,000 gal./day.

$$\frac{115 \times 4.72}{100} = \$5.43 \text{ per day.}$$

This would amount to $977.40 for a six months period.

Actually part of this pumping expenditure would go to supply the normal demand of the consumers and should not be charged to circulating flow costs. The cost to operate a six-inch diameter main amounts to $11.90 per day or $2,140.00 for a six months period. The six months period is considered sufficient to cover critical conditions due to low temperatures in the ground except for permafrost areas.

Theoretical Considerations

The velocity of 0.17 ft. per sec. produced in the service pipe by the velocity of 2.0 ft. per sec. in the water main pipe appears very low. In order to determine whether it is sufficient to prevent freezing of the water in the service pipe, additional field studies of an actual installation should be made. The following calculations are an attempt to determine, by computation of the heat losses involved, whether the 0.17 ft. per sec. is sufficient to prevent freezing of the service pipes. To make these calculations a theoretical installation will be considered.

Consider a residence located fifty feet from a water main in which a minimum velocity of 2 ft. per sec. is maintained. The house service pipe is ¾-inch diameter galvanized steel and is connected to the main by an orifice constructed similar to orifice J in the model study. The total length of the service pipe, intake and return, is 100 feet. The service pipe is not insulated. It is laid in dry, loosely packed gravel, which varies from a coarse sand to ¾ inch gravel.

The temperature of the soil adjacent to the pipe should not be below 32° F if freezing of the pipe is to be prevented. The soil temperature one foot from the pipe probably will be unaffected by the heat from the pipe. A low temperature of 25° F at depths of 8 to 10 feet below the ground surface would seem to be a safe estimate, based on data obtained in temperature observations made to depths of eight feet in the vicinity of sewer lines at Fairbanks, Alaska. Thus the temperature of the soil from the pipe to six inches away should lie between 32° and 25° F under the worst conditions to be normally expected.

A formula for computing heat loss through pipe covering is the following:*

$$Q = \frac{k(A_s - A_p)}{\frac{2.3 \log_{10}(A_s/A_p) \times (T_p - T_s)}{d}}$$

Q equals the rate of heat flow in BTU/Hour

k equals the thermal conductivity of the soil in BTU/Sq Ft./Inch/Hour/Deg./F.

A_s equals the area of the cylindrical covering of the pipe, expressed in sq. ft.

A_p equals the area of the pipe wall in sq. ft.

T_p equals the temperature of the pipe in degrees F.

T_s equals the temperature of the soil in degrees F.

d equals the distance from the pipe wall to the outside of the cylindrical covering of the pipe in inches.

The value of k can be estimated from data supplied in "Thermal Properties of Soils," by Miles S. Kersten. Values of k given for a gravel with a density of 118.2 lbs. per cu. ft., and a moisture content of 2.1 per cent, are 9.74 for a mean temperature of 40° F; and 6.34 for a mean temperature of 25° F.

The components of the formula for Q are valued as follows:

k = 8.0 Assuming the ground temperature to be between 25° and 32° F.

A_s = 3.14 sq. ft. (Area of a cylinder 1 ft. in diameter and 1 ft. in length).

A_p = 0.275 sq. ft. (See Crane Co. catalogue for pipe data).

T_p = 36° F. = ½ (32° + 40°) = Average of inflow and outflow water temperatures.

T_s = 25° F. = Assumed temperature of soil six inches from pipe centers.

d = 5.5 inches, if a 1-inch diameter pipe is used.

Substitution of those values in the equation gives a Q = 18.9 BTU per hr. per ft. of pipe.

With a velocity of 0.17 ft. per sec., a segment of water one foot long will move through the 100 ft. pipe in 9.8 minutes. Thus, the segment of water would be in contact with the service pipe for 9.8 inches.

$$\text{Heat Lost} = \frac{9.8}{60} \times 18.9 = 3.1 \text{ BTU.}$$

The total amount of heat available from the water in each foot of pipe can be computed as follows:

Heat = Weight x Temperature change °F. + Weight x Heat of Fusion.

Weight of water per ft. of pipe = 0.231 lbs.

Heat = 0.231 x (40° —32°) + 0.231 x 144 = 35.1 BTU.

Available Heat — Heat Loss = Heat Balance = 35.1 —3.1 = 32.0 BTU.

Although the temperature of the water returning to the main would be 32°, a large fraction of heat still remains in the circulating water. On the basis of these calculations, it appears that 0.17 feet per second velocity of flow in the service pipe is sufficient to prevent freezing of the water in a service pipe laid in dry gravel under the conditions assumed.

The problem of heat loss in the main water pipe is common to all systems and probably would be solved by heating the water or by insulating the main at the time it is laid, or by using both solutions together.

Conclusions

The model studies of the dual house service pipe system connected by special orifices to a single water main, in which circulating flow is continuously maintained, indicate that such systems may be practical for use in the water distribution systems for small towns and villages in the low temperature areas of the north.

Special orifices which produce the flow in the service pipes are not necessarily complicated and should be relatively easy to manufacture.

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*W. H. McAdams, Heat Transmission, Second Edition.

1954 A. W. W. A. Seattle Conference

2—Report of Technical Sessions

OUR first report on the 74th AWWA Conference, covering the highlights of the 1954 meeting, appeared in the July issue. This installment begins our reports of technical sessions at the conference*.

Water Works Practice Committee Session

Presiding officers at the open session of the Water Works Practice Committee were LOUIS R. HOWSON, Cons. Engr., Chicago, Ill.; E. SHERMAN CHASE, Cons. Engr., Boston, Mass.; and HARRY E. JORDAN, Secy., AWWA, New York City. Mr. Howson is Chairman of the Committee.

In his opening remarks, Mr. Howson explained how the Water Works Practice Committee functions. Organized in 1920, the Committee has had only two previous chairmen, the late George W. Fuller and Malcolm Pirnie. Membership of the committee consists of 15 persons selected by the AWWA Board of Directors. Committee members are distributed according to geographical location, size of community, etc.

Sixty subcommittees are at work on as many problems, with some 400 members of AWWA involved in the work on specifications, reports, etc. In general, two-thirds of the members of each subcommittee are selected from water works utilities and one-third from equipment manufacturers.

Butterfly Valves

FRED G. GORDON, Asst. Chief Engr., Bureau of Engr., Dept. of Pub. Works, Chicago, Ill., presented a report on Butterfly Valves. He stated that the specifications will cover two different seats, rubber and metal.

Rubber seated valve specifications will cover sizes from 3 to 72-in. in the 25 to 125 psi class. These valves will be considered in two categories; less than 8 ft. per sec., and less than 16 ft. per sec. Among the various items to be included in the specifications are: minimum shaft dimensions, discs, seats, bearings, stuffing boxes, minimum operational torque, electric operators, and hydraulic cylinders.

Specifications have been started on metal seated valves. There will be no limits on velocity in pipe lines. Two types of construction will be covered, as will clearance between discs and seat. Maximum leakage will be stated for 24 to 72-in. valves in the 25 and 50 psi class, and for 3 to 72-in. valves at 100 and 150 psi.

W. W. Practice Comm. Session

Presiding

Louis R. Howson
E. Sherman Chase
Harry E. Jordan

GERALD ARNOLD, Dep. Dir., Water Dept., Philadelphia, Pa., told of problems of broken 48-in. valves in which the gate was removed and replaced by the insertion of butterfly valves. Although the size of the valve was reduced from 48 to 42-in., the operation was successful and saved considerable time over replacing the old valves.

W. A. KUNIGK, Supt., Water Dept., Tacoma, Wash., spoke of experiences at Tacoma where there was a need to throttle under high pressures of 100 to 125 psi for control purposes. Mr. Kunigk used 36-in. butterfly valves and was so pleased with the operation that he wondered "what mental inertia had prevented water works men from using butterfly valves a long time ago."

GEORGE W. PRACY, Gen. Mgr. and Chief Engr., Water Dept., San Francisco, Calif., reported highly satisfactory performances since 1932 on 60-in. valves at heads of 25 to 30 ft.

ARTHUR RYNDERS, Engr. in Charge, Constr. Div., City Engr's. Office, Milwaukee, Wis., reported on 54-in. butterfly valves in operation since 1950. These valves are used on both suction and discharge of centrifugal pumps. Loss-of-head through these valves is 7 to 8 ft. at 125 psi. The butterfly valves are used as manual valves in series with automatic check valves. Mr. Rynders said that speed of closing is controlled to prevent water hammer.

Meter Specifications

In the absence of J. G. Carnes, chairman of the subcommittee on meters, the committee report was read by HARRY JORDAN, Secy., AWWA. Mr. Jordan said that the first meter specifications were prepared in 1939. The present committee has been charged with responsibility for reviewing the specifications, which are to include alternate materials for future possible national emergencies.

The committee suggests that future specifications should contain standard meter repair practices and testing procedure; number of tests, volume to be tested and per cent accuracy. Present standards for new meter accuracy often are used for repaired meters and this point raised considerable floor discussion.

In the discussion which followed the presentation of the report, LOUIS R. HOWSON, Cons. Engr., Chicago, suggested that perhaps there should be two phases to the committee work, one on new meters and one on repaired meters. MR. KUNIGK of Tacoma, Wash., suggested that the accuracy should be the same for both new and repaired meters. ARTHUR KURANZ, Mgr., Water Utility, Waukesha, Wis., believes that there should be a standard for repairing and for repaired meters in order that a utility may be paid for all the water that is sold. Kuranz reported that in Waukesha, every meter above 2-in. is checked once a year.

A representative of the Buffalo

*Reports on the sessions of Water Works Practice and Administration Committees were prepared by G. E. Symons, Consultant and Tech. Editor, Larchmont, N. Y.

Meter Co. said that all meters should be repaired at regular intervals, but that old meters could not be made more accurate than they were when manufactured. Therefore, he suggested that there be two standards of accuracy; meters less than five years old and meters more than five years old.

JOE HARPER, Vice Pres., Rockwell Manufacturing Co., suggested that meters 35 years or more old should be called obsolete and discarded. RICHARD ELLIS, Hydr. Engr., Factory Mutual Fire Ins. Cos., suggested that part of the difficulty in approaching this matter lay in the fact that some changes had been made in the specifications since 1939 and for this reason some old meters would not meet present specifications. HOWARD NEIMEYER, Distr. Engr., Indianapolis Water Co. and Louis R. Howson both reported old meters as being still accurate and meeting new meter accuracy specifications after repair.

LEWIS R. FINCH, Vice Pres. and Chief Engr., Indianapolis Water Co., asked for information on the present practice with regard to how often large meters (3, 4, 6-in., etc.) are shop tested.

MORRISON B. CUNNINGHAM, Supt. and Chief Engr., Water Dept., Oklahoma City, Okla., said that in his department the practice is to field test with a rotameter once a year and shop test if the rotameter test is not satisfactory. JAMES RAMSEY, Chief Engr. and Supt., Water Dept., Kansas City, Mo., said that his department tested 4-in. meters once a year, usually in the shop, but sometimes in the field with another meter. When shop tested, the meters are always taken apart and cleaned. ARTHUR RYNDERS, Milwaukee, said that their meters were tested with a bypass, and W. W. DEBERRARD, Chicago, said their practice was to test meters after a certain volume had passed through.

Sluice Gate Specifications

CHARLES H. CAPEN, Chief Engr., North Jersey Dist. Water Supply Comm., Wanaque, N. J., stated that the last specifications issued by his committee were dated 1941. Mr. Capen opened the discussion by asking for comments from persons who had experience with sluice gates.

D. D. GROSS, Cons. Engr., Board of Water Commissioners, Denver, Colo., expressed the opinion that the committee should consider the quality of the cast iron used. HAROLD GRISWOLD, Cons. Engr., Hartford, Conn., said he believed that specifications issued by a water utility should contain all details before the award is made to any contract bidder.

Mr. Capen asked if large gates should be tested and stated his belief that sluice gates should all have a clutch or shear pin in order to avoid jamming on closing. JOHN DETWEILER, Gen. Supt., Water Dept., Omaha, Neb., said that he had been getting experience on 60-in gates, especially on installation. LESLIE PAUL, Supv. Engr., East Bay Utilities, Oakland, Calif., raised the question of metal used in the gates, stating his belief that heavier frames should be used because sometimes the frames are found to be sprung. Mr. Paul, also, said that care should be exercised in installation or leaking around the frame might result from warpage. Installation bolts should be prevented from coming in contact with reinforcing steel and thus avoid electrolytic corrosion. E. A. SCHMITT, Washington Aqueduct, recounted an experience of grouting in a special frame. He asked if the committee is considering rubber bottom sluice gate frames and if consideration is being given to including beam strength in the specifications. (Mr. Capen replied that these suggestions would receive consideration.)

N. S. BUBBIS, Gen. Mgr., Greater Winnipeg Water & San. Dist., Winnipeg, Man., expressed the opinion that castings should be aged before machining and that this factor should be included in the specifications. VANCE LISCHER, Cons. Engr., St. Louis, Mo., noted that the committee had avoided any comment or consideration of motor operators and he believes that the motor problem is bigger than the specifications for the gates themselves. Mr. Lischer wants the AWWA to develop specifications for motor operators; he also wants the specification for sluice gates to include a section that will make it possible to use irrigation gates at low heads.

Butterfly Valves

Fred G. Gordon
Gerald Arnold
W. A. Kunigk

Meter Specifications

Arthur Kuranz
M. J. Harper
Richard Ellis

Meter Specifications

Lewis R. Finch
M. B. Cunningham
James Ramsey

Steel Pipe Specifications

ART PRICE, Spec. Engr., Dept. of Water and Power, Los Angeles, Calif., as chairman of the sub-committee on Steel Pipe Coatings, commented principally on specifications for applying cement mortar linings in place. The specifications will also apply to cast iron pipe. For cast iron pipe from 16 to 24-in., the cement mortar lining will be 3/16-in., and for pipe greater than 24-in. the lining will be ¼-in. For steel pipe, the specifications for cement mortar lining will read: ¼-in. for pipe 16 to 36-in., and ⅜-in. for pipe above 36-in.

N. S. BUBBIS, Gen. Mgr., Greater Winnipeg Water & San. Dist., said

Sluice Gates

C. H. Capen
D. D. Gross
Harold Griswold

Sluice Gates

John Detweiler
N. S. Bubbis
Vance Lischer

Steel Pipe

Arthur Price
L. J. Alexander
Ray L. Derby

that for coal tar linings in steel pipe a new lining is needed that would withstand a temperature of —40° F. and could be moved at —5° F. He told of some rather discouraging experiences with coal tar enamelled pipe in cold weather. LOUIS ALEXANDER, Chief Engr., Southern California Water Co., suggested that to avoid difficulty with coal tar enamel coatings on the outside of steel pipe, backfilling should be done with sand around the pipe before backfilling with earth. Also, if the velocity of the water within the pipe is less than 7 fps, no difficulties will be encountered with tar linings inside the pipe.

RAY DERBY, San. Engr., Water & Power Dept., Los Angeles, Calif., reported on the activities of his joint committee with the State Sanitary Engineers, which is considering back flow preventers of the superior pressure principle and other types of devices. The committee is collecting data and information on use, head loss, service, breakdown, stoppage, maintenance required, where applicable, and locations.

Research Report

DR. A. M. BUSWELL, Chief, Ill. State Water Survey Division, Urbana, Ill., reported on his committee which is studying the effect of water treatment on the carrying capacity of water mains. Work of this committee was stimulated by observations that in untreated waters the C value of water mains dropped from 130 to 120 in 50 years, but in treated waters the C value dropped 1.2 times as fast. A three year program is under way with $20,000 available for each year of study. To date a literature study has revealed only 160 articles related to changes in carrying capacity of water mains, but not one related to the change caused by treatment of the water. It has been observed that these changes in carrying capacity occur with small change in pipe diameters. The initial studies of the committee will be made on Great Lakes supplies because they offer a common type of water with practically the same chemical composition before treatment.

RAY J. FAUST, Exec. Asst. Secy., AWWA, New York City, reported that another research problem was under study at Michigan State College. This is an N.I.H. study in cooperation with the College. Michigan State is making available $16,500 a year and the N.I.H. is adding $15,000. It is suggested that the research study will require four years.

Steel Water Pipe Manual

RUSSELL BARNARD, Advisory Engr., Welded Pipe Sales, Armco Drainage & Metal Products, Inc., Middletown, Ohio, reported on the status of the manual of steel water pipe. In 1947, the original outline was submitted, and in 1949, completion of the outline was authorized. The purpose of the manual is to include data on design and detail for engineers on pipe 84-in. and smaller, and to include text references for other sizes.

Manufacturers were to provide information on products and users were to provide information on installation. The present status of the manual is a completed expanded outline. The next steps will be to place the material in Journal style, refer it to experts, draft a second expanded outline, and finally to submit it to the Water Works Practice Committee. The cost of this work is being underwritten by 13 companies. The final book will be 15 to 200 pages of journal size. The expanded outline draft is now complete and 3 to 4 months will be allowed for its review.

Other Reports and Questions

MAX SOCHA, Head, Water Works Supply Div., Dept. of Water & Power, Los Angeles, Calif., reported that the Concrete Pipe Committee had been working about seven years and had issued three specifications, but is still keeping up with progress. He suggested that changes in specifications be made concerning imbedded steel reinforcing and gave his reasons for making the suggestion.

HARRY JORDAN asked for information on activities on the west coast regarding wet barrel hydrants, particularly with reference to specifications for fire pumpers that have connections for 4, 5, and 6-in. suctions. RICHARD ELLIS, Factory Mutual Fire Ins. Co., replied that the large size suction was wanted for open pit pumping, not for connection to fire hydrants.

Water Works Administration Committee Session

The open session of the Water Works Administration was presided over by Chairman WENDELL R. LADUE, Chief Engr. and Supt., Bureau of Water and Sewerage, Akron, Ohio. Co-chairman presiding at the session was Lewis S. Finch, Vice Pres. and Chief Engr., Indianapolis Water Co. Associate presiding officer at the session was Raymond J. Faust, Exec. Asst. Secy., AWWA, New York City. Before opening the presentation of reports, Mr. LaDue explained how the Water Works Practice Committee works through 21 reg-

ular committees and how problems are assigned to committees.

Employment Survey

RAY FAUST reported on the results to date of the Task Committee which is developing data on the Employment Survey. As of the time of the report, about 50 per cent of the questionnaires on the subject had been returned. Members of the Association will recall that the questionnaire was divided into two parts: Part I for persons not employed by water utilities, Part II for persons employed by water utilities. Replies had been received from 2306 persons answering Part I, and from 2254 persons answering Part II. Since persons answering the questionnaire also mailed a reply card showing that they had returned the questionnaire anonymously, it is possible to determine those persons who have not replied.

A second mailing of the questionnaire will be made to those persons not replying, in hopes that the return can be upped considerably above the 50 per cent mark. Mr. Faust said he hoped that the results will be available at the end of the year. All results will be transferred to a punched card system and findings will be determined by an outside organization equipped for punched card analysis.

Research Report

Dr. A. M. Buswell
Raymond J. Faust
Max Socha

W. W. Admin. Comm. Session

Presiding
Wendell R. LaDue
Water Service Rules
John H. Murdock
Water Use Report
H. E. Hudson

Service Improvement
P. S. Wilson
Highway Rights
Harry B. Shaw
Water Rates
Louis Ayres

Safety Manual

Mr. LaDue reviewed the beginnings of the safety manual program, pointing out that the work began following a report by Mr. Faust at the 1950 meeting in Miami, Fla. A survey by the National Safety Council in 1951 showed that two-thirds of all accidents occurred in small businesses employing less than 100 persons. This places the water works industry in the category of those that are not safety conscious, but as Mr. LaDue pointed out the water works industry is "very small business," since 93 per cent of the 17,000 water supplies employ less than 10 persons. Perhaps an analysis of this group of businesses would indicate the water works industry to be poorer or better than the majority of small businesses.

There is a decided need for a safety program in AWWA and the development of a safety manual seems highly desirable. Mr. Faust reported that the development of the manual had made satisfactory progress, and that a first draft was now ready. When completed it probably will contain 125 pages of mimeographed material, photographs and sketches. A report on the manual can be expected at the end of the year.

Rules for Water Service

JOHN H. MURDOCH, Vice Pres. and Counsel, Amer. Water Works Service Co., Philadelphia, reported on the final draft of the NARUC report on "Proposed Rules and Regulations for Water Service." Mr. Murdoch pointed out that this draft has some objectionable features, that it is not satisfactory to any one state, that it does not grant the water utility the right to refuse service, that it does not properly cover the ownership of services and that it sets up a plumbing inspection service to be the responsibility of the water utility. Some of these and other points are definite threats to the water utility industry both public and private. Mr. Murdoch said that efforts were being continued to confer with members of the NARUC committee to have these various points reviewed and revised. NARUC is the abbreviated name for the National Association of Railroad and Utility Commissions.

Water Use

A committee on water use headed by H. E. HUDSON, Head, Engineering Subdivision of the Illinois State Water Survey has considered the functions of the sub-committee and has asked for guidance from the Water Works Administration Committee as to the scope of the sub-committee's work. Hudson pointed out that there are several phases to be investigated: (a) Determine the conflicts in water use by the assembly of voluntary and cooperative information, (b) gather data on industrial use and on domestic use. Data on industrial water use will have to relate the information to kind of production, water handling technics, and seasonal variations. Data on domestic use must encompass water using devices, sprinkling, climatic variations, commercial use, air conditioning, etc.

Industry Service Improvement

P. S. WILSON, Mfrs. Agent, Glen Ridge, N. J., appeared before the group to relate how the Fuller Award Society had been pressing for some action on a program to obtain more funds for the whole water works industry in order to insure improved services throughout the industry. Wilson pointed out that there are four methods of approaching this problem (1) a public relations program to show the public the advantages of a higher water rate and better service; (2) de-

veloping a rating system for water works to show how the weak points stand out in some systems; (3) a study of means for minimizing fund diversions; (4) a study of regulatory statutes in the several states for the purpose of developing a model statute. Mr. Wilson stated that there were many persons willing to go to work on these problems and he asked how Board action could be obtained to put the program in operation.

Mr. LaDue explained that several of these ideas were now being attacked in one way or another by existing committees, either in the Water Works Practice Committee or the Water Works Administration Committee or in Task Groups in the Several Divisions of AWWA. He suggested that those persons wishing to further the inauguration of a program such as Mr. Wilson suggested should take the problems to the Divisions where the decision could be made as to the feasibility of setting up task forces to explore the problem and could recommend action to one of the appropriate practice committees.

Highway Rights

HARRY B. SHAW, Chief Engineer, Washington Suburban Sanitary District Commission, Hyattsville, Md., reported on this problem of utility versus highway rights in the matter of moving water mains to allow for highway development. Mr. Shaw stated that the AWWA had been cooperating with other agencies in reference to Sect. 11 of P.L. 350 before Congress. He said that the Secretary of Commerce had been directed to make a study of the relocation of utilities for highway constructions and to report by Feb. 1, 1955. All interested associations are scheduled for conferences with the Secretary of Commerce and it is hoped that some concrete development will come out of the efforts so that permissive legislation will be passed making it possible for payment to be made from highway funds where relocation of utility property is necessary. Shaw called for a grass roots campaign through Congressmen and warned water works men not to be asleep at the switch. He pointed out the Federal highway program called for $700,000,000 and if utility relocations amount to only 5 per cent of that amount it will total $35,000,000. A few years ago only five or six states reimbursed water utilities for utility relocation required by highway construction. There has not been a trend toward that reimbursement among other states. If Congress passes the bill which makes it possible, perhaps a trend will be established.

Unaccounted-for Water

One of the liveliest discussions of the whole session was concerned with unaccounted-for water. There was no committee report on the subject but the question was raised from the floor. It was pointed out that there is a definite need for a definition of terms and a yardstick. It was suggested that the term "unaccounted-for" not only was unwieldy, but was inaccurate inasmuch as the water is accounted for—since it represents the difference between that pumped or distributed and that paid for.

Among the terms suggested were "unrecorded flow", "unrecorded distribution", "lost water", and "non-revenue water". It was recognized in the discussion that this "non-revenue producing" water is composed of two parts, line leakage and water consumed by customers but not paid-for because of under-registration of meters. Public consumption and fire uses usually are estimated or, in some cases, may be metered although not charged for. It appeared from the discussion that the term "non-revenue water" met with favorable consideration. Mr. Wendell LaDue asked for other suggestions for a term that could be used in place of unaccounted-for water. Such suggestion can be sent directly to Mr. LaDue or to the editor of the AWWA Journal.

Miscellany

Among the many suggestions made to the committee by the audience were several that deserve comment and may warrant study by the committee. MORRISON B. CUNNINGHAM, AWWA President at the meeting, and Supt. of Water at Oklahoma City, Okla., gave a brief report on the use of mobile equipment and described its importance to civil defense plans. He also suggested that the manufacturers of such equipment should call attention of the water works industry to the savings which can be effected through its use.

E. L. FILBY, Cons. Eng., Black and Veatch, Kansas City, Mo., reported on a commemorative stamp for the AWWA 15th Anniversary meeting next year. He suggested that persons interested should write him for information on how to further a campaign to have the stamp issued.

ARTHUR KURANZ, Waukesha, Wis., said that his committee was watching the developments in social security but had nothing to report. LOUIS AYRES, Cons. Engr., Ann Arbor, Mich., announced that the committee report on rates was completed and is now filed as a manual; it will be distributed. Problems of standardization of fire hydrant threads, and job classification were discussed briefly.

Water Purification Division Sessions

The program of the Water Purification Division was divided into three sessions which included six technical papers, eight committee reports, and two panel discussions.*

A color motion picture titled "Corrosion in Action" was shown under the auspices of the International Nickel Company; it illustrated fundamental factors causing corrosion, methods of minimizing galvanic action, and the effects of temperature.

Technical Papers

"WATER SUPPLY AT HANFORD, WASHINGTON", was described in a paper by W. R. CONLEY, Reactor Section, General Electric Co., Richland, Washington.

The story of water supply at the nuclear energy site in Hanford was told by Mr. Maynard Johnson, Unit Superintendent of Reactor Power. Water at this installation is obtained from wells in addition to a supply from the Yakima and Columbia Rivers.

Pre-chlorination, then coagulation with alum and activated-silica prepare the raw water for sedimentation and filtration. Filter effluent receives pH correction with lime. Filter rates at Hanford have been increased to 3.0 gal. per sq. ft. per min. in order to meet increased demands for water without increasing plant dimensions. Algae do not cause difficulty in water treatment at Hanford. Chlorine residuals of 0.5-1.0 ppm are maintained with bacteriological samples collected weekly. Boiler water is de-ionized, de-aerated and treated with phosphate for corrosion control. Process water for cooling purposes is treated with sodium dichromate for corrosion inhibition.

Costs for water treatment at Hanford approximate $3.00 per million gallons for coagulants, chlorine and lime. Mr. Johnson described the growth of Richland, Washington, as a new community for Hanford employees. New lawns and other activities in the arid area have imposed a water demand of 1000 gal. per capita per day.

"PHYSICAL AND BIOLOGICAL DISTRIBUTION OF RADIO-ISOTOPES IN THE

*These sessions were reported by V. W. Langworthy, Research Chemist, The Chlorine Institute, Inc., New York, N. Y.

COLUMBIA RIVER BELOW THE HANFORD REACTOR", was the title of a paper by Dr. R. F. Foster and Dr. R. E. Rostenbach, both of the Radiological Sciences Dept., General Electric Co., Hanford, Washington.

Dr. Foster presented the paper which revealed that ten years of operation in 620 square miles of sage desert have provided opportunity to study effects of nuclear energy operations in the area. Slides were used to illustrate extent of the Columbia River watershed, flow rates which contribute to an average of 4 miles per hour, temperature variations from 32.5° F. and the Hanford zone of influence from Priest Rapids to McNary Dam.

Water is used to cool the atomic piles at Hanford, which means that radioactivity is induced on solids contained in the water. Retention basins provide time for some of the radioactive materials to decay, but some isotopes remain. Dr. Foster emphasized these isotopes did not originate directly from uranium splitting, but from exposing the water to conditions within the nuclear reactor. Types of radiation encountered are of the beta and gamma types, rather than alpha particles.

Dilution factors of the Columbia River below Hanford are known, but a continuous mineral and biological analysis program is followed. Tanks containing living fish, for example, are used to insure the content of radioactive materials in waste effluent remains within safe limits.

Radioactivity measurements of any type must include inherent radioactivity, referred to as "background". Total radioactivity in the Columbia River includes "background" plus the amount added from Hanford operations. Radioactivity diminishes to approximately 10 per cent 70 miles downstream from the Hanford reactors. Isotopes of comparatively short life are found in algae, midge larvae and some fish species. Longer lived isotopes predominate in plankton, caddis fly larvae and host fish species.

Seasonal variations of radioactivity in the Columbia River are found to be high in the fall when low river flows exist and high in fish when temperatures are elevated during the summer.

Dr. Foster emphasized that no health hazard currently exists in the animal life of the Columbia River. Radioactive levels average less than 0.1 of the maximum amount allowed by the U. S. Bureau of Standards. One individual could consume 20 pounds of Columbia River fish per day per year without exceeding maximum allowable toxic limits.

Purification Division

Chairman
William Yegen
Vice-Chairman
H. C. Medbery
Secretary
H. H. Gerstein

Plastic Pipe
W. D. Tiedeman

Regenerating Cation Exchangers
J. M. Mcntgomery
Eskel Nordell

Chlorination
J. M. Sanchis
E. J. Allen

Taste Control
B. C. Nesin

Plastic Pipe Research

"PLASTIC PIPE FOR PORTABLE WATER SUPPLIES", was the subject of a report by W. D. TIEDEMAN, Exec. Dir. National Sanitation Foundation Testing Lab., Inc., School of Public Health, Univ. of Mich., Ann Arbor, Mich.

The National Sanitation Foundation experimented with plastic pipe in an effort to determine whether plastic pipe interferes with safety and quality of water, and whether water adversely affects plastic pipe. A plastic was defined as a substance that can be molded. Three types of plastics used in pipe manufacture are polyethylene, rubber modified polystyrene and cellulose acetate butyrate.

Actual production samples of 1-in. i.d. pipe were used in the studies, with 600 sq. cm. of samples exposed to test conditions. Water of varying pH was used with all samples, and accelerated tests were carried out at 35° C. One sample added color to the water, corresponding to 25-35 on the cobalt scale, indicating some leaching effect at pH 9.6.

Tastes and odors were evaluated by a panel of five individuals selected for their taste sensitivity. Four of the panel members detected taste in a 1:9 dilution of water circulated through cellulose acetate butyrate pipe. It was determined the odor originated from a jointing compound. The odors encountered were chemical or medicinal.

Twenty-three samples given extended tests showed water of pH 5.0 to be most aggressive, however no objectionable substances were extracted under these testing conditions. Outdoor exposure showed a slight change in pipe buried in acid soil. Pipes submerged in aggressive water were slightly discolored.

Rat toxicity tests were carried out, wherein rats drank only water from plastic pipe. After six months no change in rate of weight increase was noted. Autopsy showed no lesions to date, with the toxicity tests continuing to December 1954 (an 18-month period). Results of these tests indicate manufacturers recommended pipes to be safe from all aspects.

PHILIP BRITTON, Vice-Pres., Carlon Products Co., Cleveland, Ohio, discussed Mr. Tiedeman's paper. The thermoplastic pipe industry has a committee concerned with materials and size standardization as well as uniform testing procedures. Other technical associations have committees active in the plastic pipe field.

A discussion period provided answers to questions which indicated that plastic pipe has not been used in fire protection sprinkler systems. Plastic pipe will perform satisfactorily at water temperatures below 140°F, according to the speaker. Rodents, either brown or black rats, will not eat plastic pipe by preference.

Methods of joining plastic pipe seem to be limited to clamping devices which encircle pipe at fittings and adaptor locations. Plastic pipe is available in sizes of ½-in. to 6-in. i.d.

Sea Water vs. Brine for Cation Regeneration

"SEA WATER OR NATURAL BRINE FOR CATION EXCHANGER REGENERATION", was the title of a paper by J. M. MONTGOMERY, Consulting Engr., Pasadena, Calif.

Siliceous-type zeolites of former years are being replaced by styrene-base resins in the water softening field. The Weymouth Water Softening Plant of the Los Angeles Metropolitan District has 24 ion-exchange units some of which have treated a total of 4.5 million gallons per cubic foot of resin.

Mr. Montgomery explained operation at the 6.5 mgd water plant in Ventura, Calif., designed originally as a lime softening plant, where sludge disposal became a problem of major proportions. Additional water obtained from wells proved to be higher in hardness than water from the Ventura River, so cation exchange softening was installed, using the original rapid sand filter boxes. Sea water for regeneration is collected at the beach area, using beach sand as a filter. The intake is installed below mean low-tide level, with the collector system feeding to it.

Experience at Ventura's well-water plant utilizing a well-point system indicated the advisability of establishing a salt water intake at or below mean low-tide level. Salt water soon becomes exhausted from uncovered sand areas, allowing air to be drawn in at low tide. Corrosion of the collection system and storm conditions ruined the installation. A Ranney collector has been authorized as a replacement for this plant.

Raw water total hardness at Ventura averages 475 ppm, being reduced to 150 ppm in the finished water. Chemical costs during lime treatment were $55.00 per mg for purchased salt, and energy costs to pump sea water total $2.00 per mg. Costs of conversion from lime softening to ion-exchange totalled $468,000.

The ion-exchange softening plant for 550 ppm hardness well water at Ventura has 5.0 mgd capacity. Sea water intake difficulties have raised construction costs to $140,000.

Panel Discussions

Discussion of Mr. Montgomery's paper was prepared by Mr. Eskel Nordell, Highland Park, N. J. Sea water as a regenerant for cation exchanges has been reported from Mexico, South America and Japan. Calcium and magnesium ratio is higher in sea water than in commercial salt. Natural brines vary in salinity and in mineral contact. These variations should be determined by analysis and the brines used accordingly.

"CHLORINATION STATIONS—FACTORS IN DESIGN AND OPERATION CONTROL" was moderated by H. C. MEDBERY, Engr., of Water Purification, San Francisco Water Dept., San Francisco, Calif.

"PRACTICAL DESIGN FACTORS" were discussed by J. M. SANCHIS, San. Engr., Dept. of Water & Power, Los Angeles, Calif. Housing for chlorinators and associated equipment should be located as near the point of application as practicable. Buildings should be windowless, of permanent construction, artificially lighted, adequately ventilated and provided with ample floor drains.

Chlorinating equipment should be provided with a range to cover maximum and minimum flows to be treated, allowing for sufficient chlorine to satisfy the chlorine demand, and provide sufficient residual chlorine for all purposes. Standby chlorinating equipment is a must.

Equipment for handling ton containers and cylinders should be sturdy, with I-beam deflection held to a minimum. Where required, evaporators of approved design should be provided in connection with pressure reducing valves and headers of material suitable for chlorine services.

Automatic controls and recording devices should be incorporated into plant design and strategically placed for efficient utilization by plant personnel.

"OPERATING PROBLEMS" were discussed by E. J. ALLEN, Asst. Supt., City Water Dept., Seattle, Washington.

Operating problems may be held to a minimum if attention is paid to fundamental factors. Stoppages in chlorine line piping may result from the use of improper gaskets, or use of non-standard piping. Pipe dope used to excess can be the source of annoying interruptions in chlorine feed. Relief lines should be maintained free of foreign matter, including water, insects and other debris.

Chlorine hydrate occurs at low water-chlorine temperatures, beginning near 49.5°F. Its formation may be prevented by maintaining higher temperatures in chlorinator room and in chlorinator proper.

Hypochlorinator problems arise from plugged suction lines and check valve failures. Proper attention to maintenance and clean hypochlorite can reduce these problems.

"SAFETY MEASURES AND EMERGENCY CHLORINE SUPPLIES", were included in remarks by BRIAN SHERA, Mgr. Tech. Services Dept., Pennsylvania Salt Mfg. Co. of Washington, Tacoma, Wash. These included procedures which could be followed in event of civil or military interruptions to normal chlorine supply sources.

Slides were used to illustrate potential sources of chlorine for Washington water departments. Sources included were paper mills, all municipalities, two chlorine producers and military establishments. Schematic diagrams and photographs of an emergency liquid chlorine repacking station were also illustrated. Ton containers may be used to fill chlorine cylinders with scales and other equipment normally found at water works.

Questions from the floor answered by Mr. Shera included installation of a filter intended to remove chlorine impurities. A large diameter pipe, reduced at each end to chlorine pipe size and filled with coke and glass wool, will serve as an effective filter in most cases. "Taffy" may be avoided if chlorine piping is pitched properly to slope upwards from cylinders and other pressure vessels containing chlorine. "Taffy" may be removed from piping by means of steam and hot water, then passing dry air through the system.

Taste and Odor Control

"NEW APPROACHES TO THE CONTROL OF WASTES AND ODORS IN IMPOUNDED WATERS" was moderated by R. E. DOESON, JR., Supt. of Production, Water Dept., San Diego, Calif. Purpose of this panel discussion was to describe new techniques in controlling aquatic growths in reservoirs.

Eastern practice was discussed by B. C. NESIN, Director of Laboratories, Dept. of Water Supply, Gas and Electricity, Mt. Prospect Laboratory, Brooklyn, N. Y. Time permitted Mr. Nesin to cover only those taste and odor control activities in the New York City water supply. It was reported that copper sulfate and chlorine continue to be applied for control.

A significant change is the addition of copper sulfate on a continuous rather than intermittent basis.

Synura has caused problems in both the Croton and Catskill reservoir the Croton and Catskill reservoir systems, but super-chlorination (2.0 ppm free chlorine) controls this organism effectively. It was indicated that 2 pounds per million gallons of copper sulfate are required, when chlorine is not used, to control Synura blooms. Tastes and odors due to Synura will not respond to treatment of less than 1.4 ppm of free residual chlorine.

Experiments under way during 1954 were illustrated with lantern slides. A copper sulfate feeding system was illustrated which is intended to operate on a continuous basis. Treatment program for 1954, as described by Mr. Nesin, is to suspend copper sulfate treatment at Muscoot reservoir, but add chlorine and copper sulfate at Croton. This is followed by four or five-day detention at Jerome park reservoir, with chlorination as the water leaves Jerome park. Auxiliary copper sulfate is to be added at the 135th St. gate house, followed by eight days detention in Central Park reservoir.

"Western Practice" was discussed by R. L. Derby, Prin. San. Engr., Dept. of Water and Power, Los Angeles, Calif. The Western United States covers a wide area; mountainous and desert regions each cause distinct problems of water supply and treatment. In general, however, taste and odor problems remain most critical in warm areas. The green and blue-green algae, diatoms and aquatic weeds predominate as troublemakers.

At San Diego, copper sulfate snow is distributed evenly throughout a reservoir from a surplus landing craft, converted for the purpose. Weed killer proves effective for cat-tails when sprayed from the shore and water surface.

At Los Angeles, simple chlorination is effective for taste and odor control. Pond weeds and plankton are controlled with dosages of 0.8-1.0 ppm of copper sulfate. This treatment is applied only during summer and fall months, being discontinued in October. Copper sulfate is fed as a solution from a constant head tank and as a powder from a blower and belt type distributor.

Silver Lake reservoir receives mixed water from the Owens and Colorado River Aqueducts. Chlorination experiments have led to the installation of three chlorinator locations to effect taste and odor control.

New Product
J. K. G. Silvey
Fluoridation
W. Leslie Harris
Detergents
Paul D. Haney

Water Manual
H. E. Lordley
Chemicals
J. E. Kerslake
Liquid Chlorine
L. L. Hedgepeth

New Method of Control

A new method of taste and odor control as tested at Oklahoma City was described by Dr. J. K. G. Silvey, Chairman, Div. of Science, North Texas State College, Denton, Texas. The procedure involves the use of an activated cellulose compound, termed "S-C Product". The report was not presented as a panacea for tastes and odors in water purification, but rather as an available material for further experimentation.

Tastes and odors for which the product appears to be specific are those originating from actinomycetes-infected algae. Common odors observed under such conditions might be termed grassey, musty, hay-like or potato-like. Tastes observed to be woody, or like rotting wood, receive treatment similar to that given during periods of high odor intensity.

Two years of experimentation using chlorine, chlorine dioxide, activated carbon and an aqueous extract of experimental "S-C Product" have included 20 types of actinomcyete odors having threshold concentrations of 40. Procedure includes at least 3.0 ppm pre-chlorination, and 10 ppm "S-C Product" in addition to regular plant dosages of lime and alum or other coagulants. Treatment in this manner should reduce threshold odor to 3, which may be further lowered by addition of 4 to 5 ppm activated carbon. In any case, jar tests should be made in order to determine the minimum effective dose for any given taste and odor problems.

Committee Reports

Instrumentation and Methods of Testing Radio-Active Contamination, H. H. Gerstein, Chairman.

This Committee made its first report at the Kansas City Convention in 1952. Formal report was rendered in July 1952 by the Committee which has since functioned on a standby basis. Eight papers have appeared in the A.W.W.A. Journal concerning accuracy of radioactivity counting methods. A standard method is being prepared to facilitate low level radiation counting. The committee has indicated the need for standard nomenclature to define radioactivity in water.

Standard Methods for the Examination of Water and Sewage, R. L. Derby, Chairman, reported all all Tenth edition material has been submitted to the printer. Publishing date remains uncertain, pending return of galley proofs.

Fluoridation Materials and Methods, W. L. Harris, Chairman.

In the absence of Mr. Harris, the report of this committee was read by H. C. Medbery. As of March 1, 1953, 871 communities in the United States were adding fluorides to water supplies serving 16 million people. The chemical used for fluoridation usually is sodium fluoride or sodium silicofluoride.

Court action against water supply fluoridation has been initiated in Shreveport, La., Peekskill, and Fulton, N. Y., and Tulsa, Okla.

Feeding problems have not included arching, but some lumping due to excessive moisture content has been reported. A specification appears desirable which will limit permissible mesh sizes. One installation of a continous fluoride recorder has been reported. Based on conductivity measurements before and after fluoride addition, the unit is undergoing tests

at the Salem-Beverly, Mass., water plant.

EFFECTS OF SYNTHETIC DETERGENTS ON WATER SUPPLIES, P. D. HANEY, Chairman.

Problems resulting from synthetic detergents in raw water supplies are found to be complex. Detergents are expected to continue to grow in popularity in this country, having reached a use of 800 million pounds in 1953.

An analytical method for synthetic detergents in water is being studied, together with procedures for determining the phosphates used as builders in some syndets.

Plant experiences which have been reported include foaming, tastes, odors, sedimentation difficulties, poor iron removal, and quality deterioration in the finished water.

REVISION OF MANUAL OF WATER QUALITY AND TREATMENT CHAPTER ON MIXING AND SEDIMENTATION, H. E. LORDLEY, Chairman. This chapter is being revised to include certain new information on detention time.

SPECIFICATIONS AND TESTS FOR WATER PURIFICATION CHEMICALS, J. E. Kerslake, Chairman.

Specifications for thirteen chemicals have been published, with six in process. Work on a specification for liquid chlorine was installed during the Seattle Conference. L. L. Hedgepeth heads the task group which includes association members and representatives from the chlorine producing industry.

Sewage and Industrial Waste Treatment for Aukland, N. Z.

John B. Rowntree, Designing Engr. for the Aukland (New Zealand) Metropolitan Drainage Board, takes exception to the statements of Dr. F. W. Mohlman in our February 1954 issue concerning the proposed treatment of sewage and industrial wastes for Aukland, N. Z. The article in question is Dr. Mohlman's review of "Sewage and Industrial Waste Developments of 1953."

Engineer Rowntree calls our attention to the fact that at the time of the review the proposal of the Aukland Metropolitan Drainage Board was:

(1) Provision for treatment of all domestic and industrial sewages from the entire metropolitan area.

(2) Treatment of meat packing wastes at a separate treatment plant.

Extensive pilot plant experimental studies of methods of treatment of sewage and meat plant wastes have been made and are continuing.

With specific reference to the meat waste problem, Mr. Rowntree calls attention to the shock loads from the packing industry, due to the 5-day, 8-hour operations and thus far no satisfactory standard tests are available for application to effluents such as Aukland's under Aukland conditions.

As noted on page 90A of our May 1954 issue, Aukland has only recently retained a panel of five experts from America and England to study and report on the Aukland situation in respect to sewer construction and treatment problems. At this writing these experts are in Aukland. They are A M Rawn of Los Angeles; Chas. Gilman Hyde of Berkeley, Calif.; D. H. Caldwell of San Francisco; J. T. Calvert of London; and Dr. H. Wilson of London, who is President of the Royal Institute of Sewage Purification.

Photo Correction: E. M. Jones Representing WSWMA

In our first report of the AWWA Seattle Conference (July issue, page 304) we listed E. M. Jones, Vice Pres., Simplex Valve Co., Philadelphia, Pa., as an AWWA Director representing the WSWMA. Unfortunately the photo used was that of F. W. Jones.

Houston's Filtration Plant Cost Per MGD is Less Than Reported

In his article, "Multiple Water Treatment Units — A Continuing Experience Report," in the June 1954 issue of this magazine, E. H. Aldrich, Vice-Pres. and Chief Engr. of the American Water Service Co., published a chart titled "Comparative Construction Costs of Conventional Filter Plants and Multiple Water Treatment Units." This chart reveals the cost of the new filter plant of Houston, Texas, at $150,000 per MGD capacity.

Author Aldrich states that N. P. Turner of Freese, Nichols & Turner, consulting engineers, of Houston, and designers of the new Houston plant, has called his attention to an error in the chart and requests that this correction be run.

Actually the per MGD capacity of the Houston plant can be computed to cost $100,000 rather than the $150,000 shown on the chart. The explanation is found in the fact that the plant was designed and built for 50 MGD output at a filter rate of 2 gal./sq.ft./min., whereas its present capacity at the same filter rate is only 30 MGD. It is estimated by Freese, Nichols & Turner that when the Houston plant is expanded to the full 50 MGD capacity the complete cost will be in the neighborhood of $5,000,000, thus bringing the ultimate cost per MGD down from $150,000 to $100,000. The latter figure includes raw water pumping and finished water pumping facilities in addition to the complete filtration plant and purified water storage, as well as all paving and landscaping costs.

Author Aldrich requests that we run this correction and suggests that the dot for the Houston plant may properly be moved over to the 50 MGD line on the chart appearing on page 253 of the June issue of WATER & SEWAGE WORKS. The new position places the Houston plant cost, when completed for 50 MGD capacity, at $100,000 per MGD. This point is slightly above the "Cost Trend Line for Conventional Filters" but is somewhat lower than the capacity-costs for the plants of Fort Worth, Texas, and Wichita, Kansas.

Dale Maffitt Receives Governor's Plaque

When Dale M. Maffitt, left above, president of the Des Moines, Iowa, Water Works was elected to the presidency of the American Water Works Association at its annual convention in Seattle recently, Iowa's Governor William S. Beardsley awarded him a parchment plaque in recognition of his outstanding contribution to the field of water works engineering.

The presentation was made in behalf of the Governor by Joseph P. Lawlor, Mayor of Ames, Iowa, and president of General Filter Company.

Designing, Constructing and Maintaining Centrifugal Pumps

Part 1—Types and Classifications

by **ROY CARTER** *and* **IGOR J. KARASSIK**, *Engineers,*
Worthington Corp., Harrison, N. J.

AT THE beginning of this century, steam engines constituted the primary source of power. Steam turbines were in their infancy, and electrical power, as we now know it, was non-existent. Water was supplied by gravity flow or, in the major cities, by mammoth steam-driven pumping engines. Sewage treatment was almost unknown and practically no sewage was pumped. Centrifugal pumps were inefficient; they were used primarily for low head, large volume pumpage with direct-connected low-speed steam engines for driving power.

The development of electric power and of the steam turbine, providing sources of high speed rotating power, did much to make the use of centrifugal pumps advantageous. Expansion of industrial processes in the last half-century has created such demands for multi-service pumps that, in addition to regular general service pumps, every manufacturer has various special lines for specific fields such as chemical, pulp and paper, sewage, etc.

To treat centrifugal pumps in all-inclusive detail would require lengthy discussion and would involve many designs of little or no interest to the readers of *Water & Sewage Works*. Hence this series of articles, discussing the structural details and maintenance of centrifugal pumps, will deal principally with the types normally encountered in water works and sewage plants. Only minor attention will be given to features of other types of centrifugal pumps. Features of such pumps developed for one field of application, however, often find a modified application in other fields; for that reason, our discussion should not be too restrictive.

Messrs. Carter and Karassik are well known to readers of *Water & Sewage Works* for their series of articles, "Basic Factors in Centrifugal Pump Application" and "Basic Factors in Preparing a Centrifugal Pump Inquiry" which we published in 1951-52.

We are pleased to present this new series covering the design, construction, and maintenance characteristics of centrifugal pumps for water and sewage service.

Mr. Carter, manager of the Volute Pump Section, Centrifugal Pump Division, received A.B. and M.E. degrees from Columbia University, and has been employed by Worthington Corp. since 1923.

Mr. Karassik, manager of the Multistage Pump Section, Centrifugal Pump Division, received B.S. and M.S. degrees from Carnegie Institute of Technology, and has been employed by Worthington Corp. since 1934.

How the Pump Functions

In a centrifugal pump, atmospheric or other pressure forces the liquid into a set of rotating vanes. These vanes form an impeller which discharges the liquid at its periphery at a higher velocity. For useful application, the discharge velocity must be converted into pressure energy. This is accomplished by a volute (Fig. 1) or by a set of stationary diffusion vanes (Fig. 2) which surround the impeller periphery. Pumps having volute casings generally are termed volute type pumps, while those having diffusion vanes are termed diffuser type pumps. Formerly, diffuser type pumps were commonly termed turbine pumps, but, of recent years, this terminology has become restricted to vertical deep well centrifugal diffuser type pumps. The latter type now are generally termed vertical turbine pumps.

It is difficult to visualize the path followed by liquid passing through a centrifugal pump, as the casing is stationary and the impeller is rotating. Figure 1 illustrates a modern type of end-suction volute pump, and the line from point A shows the path followed by a specific liquid particle. The direction of the line is based on operation of the pump at rated capacity (the capacity at which best efficiency is obtained).

Centrifugal Pump Classifications

In addition to the classification based on energy conversion, centrifugal pumps have many other subdivisions; several of these deal with the impeller. First, impellers are classified (according to the major direction of flow with reference to the axis of rotation) into axial flow, mixed flow and radial flow types.

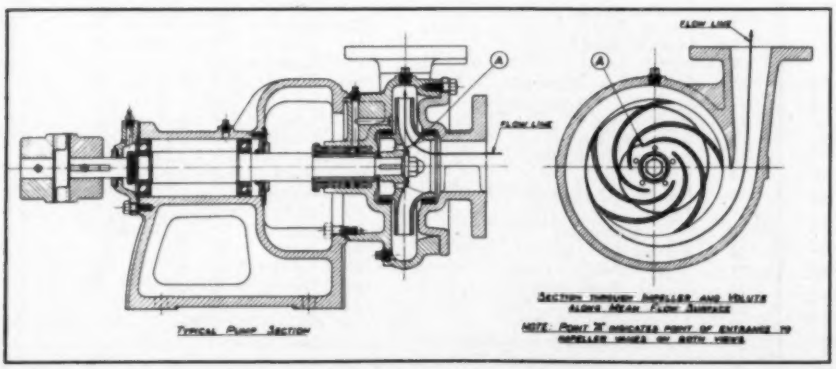

A
FLOW LINE
A
FLOW LINE
TYPICAL PUMP SECTION
SECTION THROUGH IMPELLER AND VOLUTE ALONG MEAN FLOW SURFACE
NOTE: POINT "A" INDICATES POINT OF ENTRANCE TO IMPELLER VANES ON BOTH VIEWS

Fig. 1—TYPICAL single stage volute pump

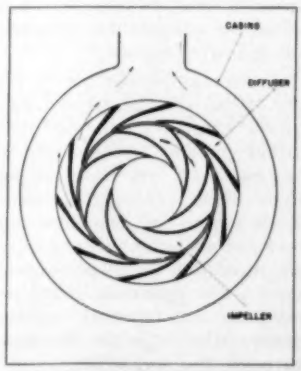


Fig. 2—DIFFUSER type pump

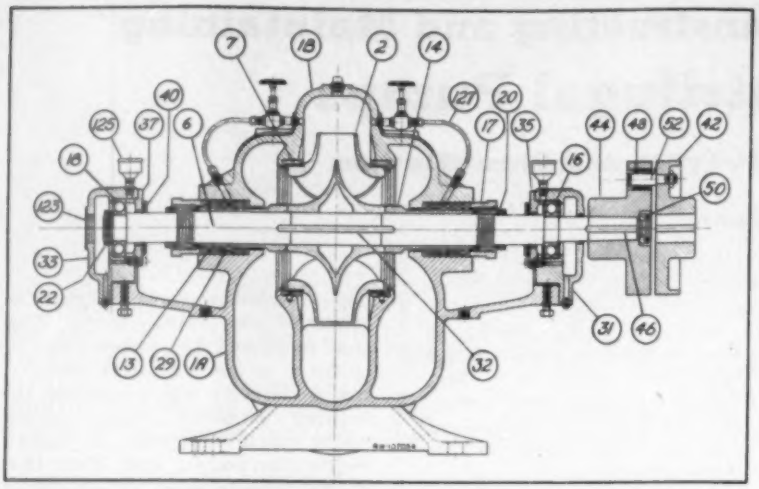


Fig. 3—PARTS of a horizontal shaft, single stage double suction volute pump

Further impellers are classified as to the flow into the suction edges of the vanes; i.e., from one side (single suction) or from both sides (double suction). Their mechanical construction provides a further subdivision of impellers into: (1) enclosed, with shrouds or side walls enclosing the water ways; (2) open; and (3) semi-open or, as sometimes termed, semi-enclosed.

If the pump is one in which head is developed by a single impeller, it is called a single stage pump. Often the total head required necessitates the use of two or more impellers operating in series, the second impeller taking its suction from the discharge of the first, etc. This might also be accomplished by connecting two or more single stage pumps in series, or by incorporating all the required impellers within a single casing; when this is done, the pump is termed a multi-stage pump.

The mechanical design of the casing provides other clasifications (axially or radially split), as does the axis of rotation (horizontal shaft, vertical shaft and inclined shaft pumps). Usually the word shaft is omitted, and the simple terms horizontal or vertical are used to denote the axis of rotation.

Some pumps operate in air, with the liquid coming to and conducted away from the pumps by piping. Other pumps (usually only those of vertical shaft type) are submerged in their suction supply. Thus vertical shaft pumps are classified as dry pit and wet pit pumps. Wet pit pumps of the axial-flow or mixed-flow diffuser type (now generally called propeller pumps), or vertical turbine type pumps discharge the liquid upward, through the supporting drop or column pipe, to a point of discharge above or below the supporting floor. Accordingly, these types of pumps are designated as above-ground discharge or below-ground discharge.

As implied above, horizontal shaft pumps universally operate in air, the liquid being piped to or from the pumps. The location of suction openings into the pumps provides the classifications of end, side, bottom, and top suction. The location of the discharge from the pump leads to the classifications of side, bottom and top discharge; the term end discharge also is possible in the case of horizontal shaft propeller pumps.

While the basic elements of a centrifugal pump are an impeller, a casing, a shaft, and shaft bearings, a pump must have supplementary parts. The different names given to pump parts by various manufacturers often lead to confusion. Figs. 3, 4, and 5 show typical pump construction. Fig. 3 illustrates a horizontal-shaft, double-suction volute pump. Fig. 4 illustrates a vertical-shaft, dry-pit single-suction volute pump. Fig. 5 illustrates the bowl section of a single-stage axial-flow propeller pump. The various parts of these pumps are numbered and the corresponding names (Table 1) are those recommended by the Hydraulic Institute for these parts.

Centrifugal Pumps for Water Works Service

The types of centrifugal pumps most frequently used in the water works field are:

(1) Horizontal-shaft, end-suction, single-stage volute type, either frame or motor mounted.

(2) Horizontal-shaft, double-suction, axially-split case volute type, usually with side discharge and side or bottom suction. Occasionally a bottom-suction, bottom-discharge type is used.

(3) Horizontal-shaft, single- or double-suction multistage (usually two or possibly three stages) volute pumps.

(4) Series units, consisting of two or occasionally three horizontal-shaft, double-suction, axial-split case volute pumps connected in series, with separate or common driver.

Table 1
Recommended Names of Centrifugal Pump Parts

Item No.	Name of Part	Item No.	Name of Part
1	Casing	33	Bearing Housing (Outboard)
1A	Casing (Lower Half)	35	Bearing Cover (Inboard)
1B	Casing (Upper Half)	36	Propeller Key
2	Impeller	37	Bearing Cover (Outboard)
4	Propeller	39	Bearing Bushing
6	Pump Shaft	40	Deflector
7	Casing Ring	42	Coupling (Driver Half)
8	Impeller Ring	44	Coupling (Pump Half)
9	Suction Cover	46	Coupling Key
11	Stuffing Box Cover	48	Coupling Bushing
13	Packing	50	Coupling Lock Nut
14	Shaft Sleeve	52	Coupling Pin
15	Discharge Bowl	59	Handhole Cover
16	Bearing (Inboard)	68	Shaft Collar
17	Gland	72	Thrust Collar
18	Bearing (Outboard)	78	Bearing Spacer
19	Frame	85	Shaft Enclosing Tube
20	Shaft Sleeve Nut	89	Seal
22	Bearing Lock Nut	91	Suction Bowl
24	Impeller Nut	101	Column Pipe
25	Suction Head Ring	103	Connector Bearing
27	Stuffing Box Cover Ring	123	Bearing End Cover
29	Seal Cage	125	Grease (Oil) Cup
31	Bearing Housing (Inboard)	127	Seal Piping (Tubing)
32	Impeller Key		

(5) Vertical-shaft, single-suction, single-stage dry-pit volute pumps.

(6) Vertical-shaft, wet-pit single- or multi-stage turbine or propeller pumps.

Other types of centrifugal pumps also are applied to water works service, but so infrequently that they are not tabulated.

Small Capacity Pumps

The horizontal end-suction single-stage volute pump either frame or motor mounted is an ideal design for small capacities (up to 800 gpm at 3600 rpm and up to 2500 gpm at 1800 rpm). It has not found a very wide acceptance in water works. One reason is that many of the pumps of this type, particularly the frame-mounted version, have been light-duty units made for intermittent operation, and hence not suitable for water works service. Most manufacturers currently have substantial designs as well as light-duty units made in this construction. The substantial designs, both frame and driver mounted types, are volume built—usually with impeller designs to load up standard size motors. They are standardized, more-or-less production line products, and in most cases are built in stock lots. Because prices of these units are low, the manufacturers cannot tailor the impellers for specific service conditions, nor can they afford to make special tests to demonstrate pump performance.

For small capacity water works service this type of pump has considerable application. The horizontal end-suction single-stage volute pump can be obtained at reasonable cost if purchased as an industrial concern would purchase it—that is, without detailed specifications, requirements, guarantees, etc.

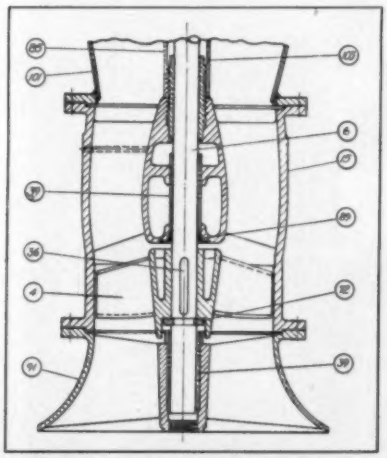


Fig. 5—PART of a vertical shaft, wet pit diffuser pump bowl section

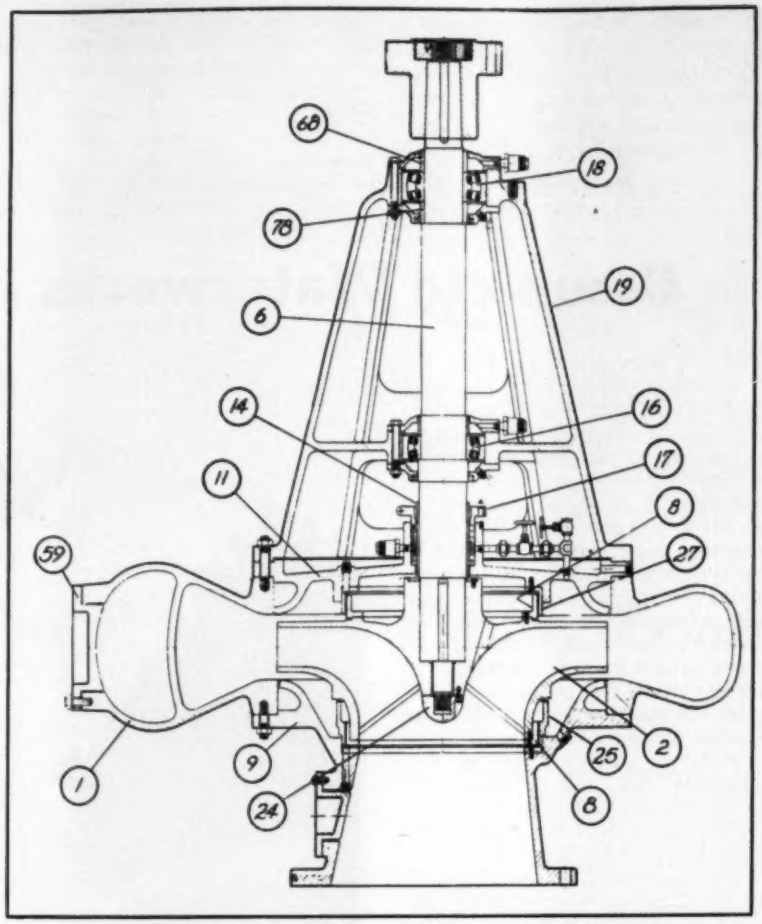


Fig. 4—PARTS of a vertical shaft, single end suction volute pump

Medium Capacity Pumps

In general, the horizontal-shaft double-suction volute pump is most commonly used in water works service for medium capacities up to 20 mgd, and for heads up to 300 feet or more. At about this capacity, vertical-shaft single-suction, single-stage volute pumps (Fig. 4) sometimes make a more economical installation when all factors are taken into account. In the 20 to 40 mgd capacity range local conditions may favor either type, but over 40 mgd the probabilities are that the vertical-shaft single-suction, single-stage volute pump would be the more economical type.

Well Pumps

Naturally for pumping from deep wells the vertical turbine pump is universally used. There has been some tendency to use this type to pump from shallow wet-pits in place of the conventional horizontal-shaft or vertical-shaft dry-pit types. While the vertical turbine pump installation in many cases has a lower first cost, the horizontal-shaft or vertical-shaft dry-pit pump generally has a much lower maintenance cost and, hence, is the favored type.

Sewage Pumps

Pumps suitable for pumping sewage must satisfactorily pass the solids contained in the sewage. Among sewage solids, rags and string give the most trouble; except for very large pumps having stationary covers over the shaft, the use of pumps having shafts which project through the suction waterways is undesirable. For the same reason, diffuser vanes having thin edges which catch rags and string also are undesirable.

Nearly all sewage pumps, therefore, are of the end-suction volute type having impellers on the end of shafts. In general, the impellers are of special non-clogging design. As most applications are for low heads (up to 70-80 feet maximum) for small capacity pumps, and up to 40 to 50 feet maximum heads for large capacity pumps, single stage pumps

can be used. Usually the vertical dry-pit type is installed at an elevation below the suction supply, so that priming is not necessary. In some cases a wet-pit vertical type is used for intermittent duty.

The same general design of end-suction pump having special non-clogging impellers is used for pumping secondary and activated sludge, and for sludge recirculation in sewage treatment plants. For recirculating settled sewage which contains no large solids or stringy materials, axial-flow wet-pit propeller pumps often are used.

For storm water pumping, both the wet-pit axial—or mixed-flow propeller pump type and the dry-pit vertical or horizontal volute types are used, depending on what best meets the individual problem.

* * *

Part 2 of this series will discuss casing construction and pump maintenance.

Complete Waterworks in a Tower

THE Village of Aroma Park, Ill., saved approximately $500 by using the base of a 50,000-gal. Watersphere as the pumphouse in its water system.

The base of the tank, which serves as a pumphouse, is insulated and has a ceiling 14 ft. above the floor. It houses a 100-gpm electrically-driven deep well pump and 7½ hp motor, an ion-exchange softening unit, chlorinating equipment, laboratory table, and automatic pump controls. The softener, which has a maximum capacity of 126 gpm, is operated at an average of 50 lbs. per sq. in. and 85 gpm, the hard-water by-pass taking another 15 gpm.

Water is obtained from an 8-in. limestone well, 182 ft. deep. The Watersphere, which is 95 ft. 10 in. to the bottom of the water capacity, was built directly over the well.

The distribution system consists of 19,400 ft. of distribution mains ranging from 2 to 8 in. in diam. It supplies 140 domestic services, 10 commercial services and 22 fire hydrants. Consumption ranges from 15,000 to 30,000 gpd and averages 20,000 gpd.

Aroma Park is 65 mi. south of Chicago, on the Kankakee river. Its population is 550 and its area. 0.34 sq. mi.

The Aroma Park water system was designed by Warren & Van Praag, Inc., Consulting Engineers of Decatur, Ill., and installed in 1951. The Watersphere was fabricated at the Chicago plant of the Chicago Bridge & Iron Co.

* * *

We will be pleased to have our readers tell us of similar waterworks already in existence, and of any special advantages or operating problems they may possess.

* * *

TOP VIEW—Outside the plant

The 50,000 gal. Watersphere provides storage for the supply of chlorinated and softened well water.

BOTTOM VIEW—Inside the plant

Superintendent Pruet entering doorway of the combined pumphouse and treatment plant which includes softening and chlorinating equipment.

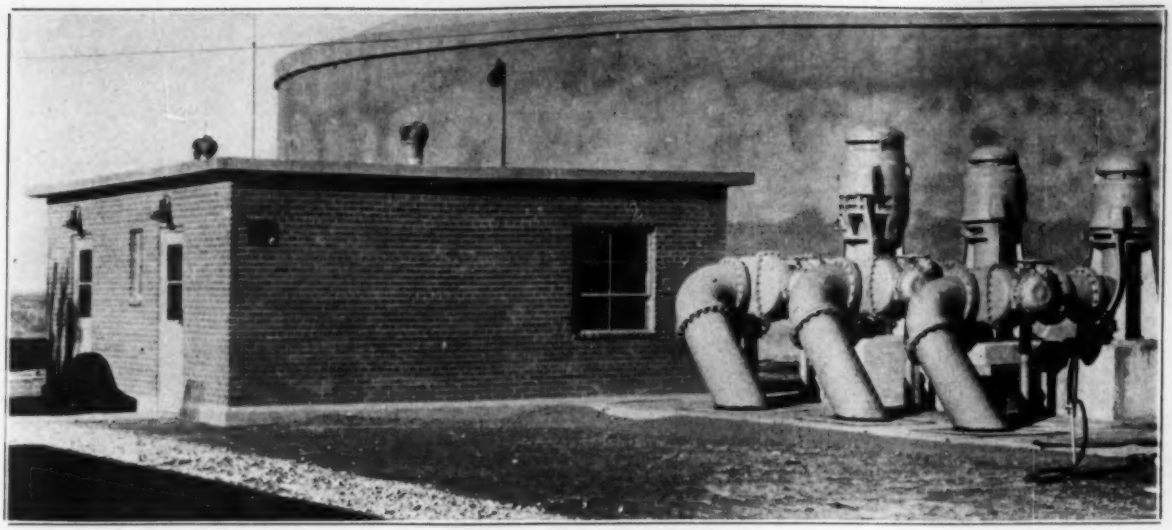


Fig. 1—HIGH SERVICE outdoor pumping station and control house at Midland, Texas

New Water Supply for Midland, Texas

Special features are the outdoor high service pumping station and centralized control of well pumps

by **H. N. ROBERTS**, *H. N. Roberts & Assoc., Cons. Engrs. Lubbock, Texas*

MANY cities in West Texas, especially those near oil field activities, find population increase to be a constant problem to their governing bodies and utility managers.

The city of Midland, Oil Capitol of the Permian Basin in Texas, is an example of such growth. With a census population of 21,756 in 1950, a careful estimate of the population made in June 1952 showed the population had increased to 34,000. An estimate projected to 1957 gave the population figure at 52,000!

This situation required speedy action. The City Administration submitted a bond issue of $7,870,000 to the people in an election held in September 1952. As is generally the case under such conditions, the bond issue carried by a large majority; the need for the improvements, especially the new source of water supply, was evident to all citizens.

Considerable thought had previously been given to the constant increase in population by the City Manager and his staff. In 1950, at the request of city officials, the West Texas Geological Society appointed a committee, Ed L. Reed, Chairman, to make a preliminary study of available data relative to the location of water-bearing aquifers in the area around the City. The report showed several possibilities in specific areas. In October 1951 the Layne-Texas Company was engaged by the City to drill a series of some 60 test holes and temporary wells for flow testing in an area some 8 miles northwest of the City.

At the same time the author's firm was engaged to supervise this exploration and flow test work, and to make hydrologic studies of the aquifiers.

Ground Water Occurrence

In the vicinity of Midland the areas of prolific water are found to occupy narrow, linear belts, generally in a southeasterly direction. Investigation reveals these belts to be remarkably coincident with narrow, sinuous depressions, or "draws", which characterize the topography of the South Plains. It is believed that these draws are vestiges of what once were major streams, extending northwest to the Sacramento-Guadalupe Mountains, and draining the South Plains area into the Colorado-Brazos River drainage system.

These ancient streams eroded through the above-described succession of limestones, shales and sandstones, finally cutting down into the "red bed" section. Frequently these streams cut down through outliers of the Comanchean Cretaceous layer, from which index fossils such as Gryphea Marcoui were eroded. These fossils were deposited in the reworked material filling the ravines, together with Ogallala material, showing that the ravines are post-Ogallala in age. Subsequently, as the result of wind and surface water erosion, the ravines were filled with sands and clays, until today they are the almost obliterated remnants of a once extensive drainage system.

Table 1
CONTRACTS FOR WELLS—1952

Contract No.	Awarded to	For	Approximate Amount
152	Texas Water Wells, Inc.	Wells & Test Holes	$ 69,540
252	Permian Equipment Co.	Well Equipment	22,706
352	R. B. Hodgson & Co.	Gathering Lines, Pump House, etc.	283,725
452	H. B. Zachry & Co.	Ground Storage Res.	134,737
552	Pittsburgh-Des Moines Steel Co.	1 MG Elev. Tank	153,950
652	Sira-McKenzie Co.	30" Supply Line	502,586
			$1,167,244
	CONTRACTS FOR WELLS—1953		
153	J. D. Henderson	Pumpers Residence	$ 11,740
253	Velvin Construction Co.	Edgewood Pump Sta.	58,238
			$ 69,978

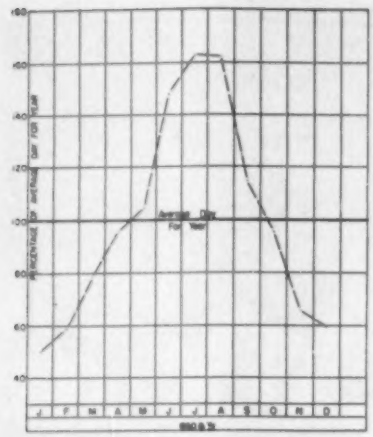


Fig. 2—AVERAGE daily water pumpage for each month charted on a percentage basis

All underground water in the Panhandle-South Plains is derived from rainfall, and is mostly found in the Ogallala and post-Ogallala sand, gravel and silty sand deposits.

Water Demand

With many fine homes in this oil Capitol it could be expected that the rate of water usage would be high, especially with the existing low average annual rainfall of about 15 inches. The average water consumption for the calendar year of 1950 was 172 gal. per capita per day, and for 1951 it was 195 gal. (See Figs. 2 and 3.) It is estimated the consumption will become 226 gal. for 1953 and 275 gal. for 1957. The maximum usage for these two years was estimated as 500 and 585 gal. respectively.

Contracts for Wells

In order to develop the new (McMillen) well field the following contracts were awarded by the City Council during September 1952. The engineers had been working on plan preparation for some time, and the contracts listed in Table 1 were ready to let.

The contracts listed in Table 1, together with incidental and other costs and some $300,000 which was paid for water rights, brought the cost of the new development to more than $1,600,000.

The project was so set up that it was planned to deliver water to the City on June 1, 1953. The supply line was completed on May 31 of that year and the first water was delivered to the City from the project on June 7, 1953.

Unusual Features

Some of the unusual features of the project were the outdoor high service pumping station and the centralized control of the well pumps (the layout is shown in Fig. 4). The first feature is shown in Fig. 5, which illustrates the three Peerless Hydrofoil pumps driven by 440 volt motors. The smaller pump has a United States Motor and the larger ones have General Electric Motors. The capacity of

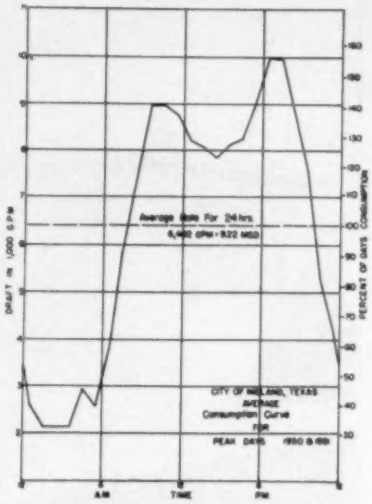


Fig. 3—AVERAGE daily rate of water consumption charted on a percentage basis

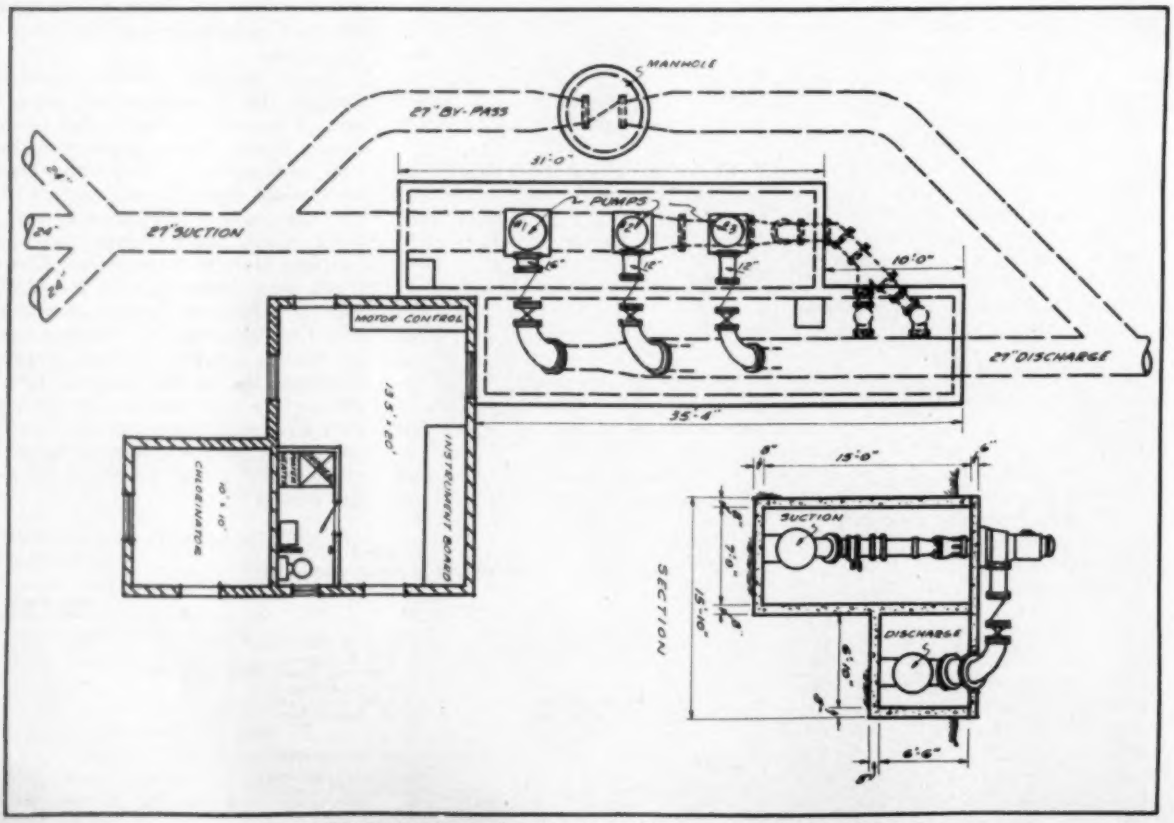


Fig. 4—DIAGRAM of pump layout and control building, in Midland installation

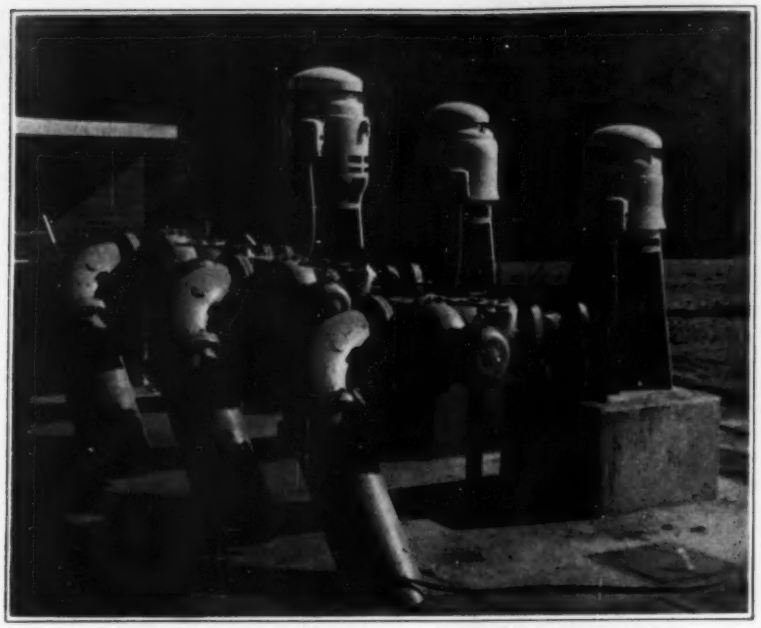


Fig. 5—PUMPING UNITS in the outdoor high service station

each of these pumps was specified to be 5000 gpm at 30 ft. head, 6500 gpm at 42 ft. head, and 8000 gpm at 60 ft. head. A corner of the small control house appears in the left background of Fig. 5. The motor control center and the instrument panel are located in this control house (also shown in Fig. 1).

Another unusual feature is the control system of the twelve well pumps. A Sparling meter is placed on the discharge line from each well. The control system requires a five-wire connection to each meter. The wire is No. 19 insulated copper, in a plastic sheath, of a type made by Ansonia Electric Co. for overhead telephone cable service. The cable is strung on the utility company's power poles. The largest size cable contains 51 pairs of wires, thus leaving 42 wires for additional wells and for spares.

Recording Instruments

A Sparling Stripograph Recorder for each six wells is mounted on the instrument panel shown in Fig. 6. At the bottom of the recorder there is located a blinking red light and a register for *each* of the six wells, while the Striptograph Recorder shows a chart recording of the flow of the six wells *combined*. So long as the small light at each well register is blinking, the operator knows that water is passing through the meter at that well.

There is a second recorder which combines the two striptograph records and shows the combined flow from the twelve wells. On the upper left of the instrument panel are shown the green and red signal lights for each of the twelve wells, as well as a hand switch for each well by which the operator can turn any of the twelve wells on and off at will. The indication of these lights and the blinker lights beneath each well register shows the operator just what wells are operating.

On the panel is also mounted a third Striptograph Recorder which shows the combined flow from the high service pumps illustrated in Fig. 5. The Metameter recorders on the panel provide charts showing the elevation of water in the ground storage tanks near the field high service station, and in the stand pipes in the city. Completing the panel are the usual pressure gauges and voltmeter, as well as two sets of Limitorque Controls for motor-operated 20-in. valves.

Good Public Relations

There is another feature in connection with the project which deserves emphasis. From the inception of the job until its completion there existed complete friendliness and cooperation among city officials, citizens, various contracting organizations and the engineers. Although as many as four contractors were working on the job at the same time, no incidents involving petty jealousy or discrimination developed, and there were no attempts to evade or shift responsibility. These fortunate circumstances were due to the good public relations job done by the City Administration, and to the high calibre of persons involved in all phases of the work.

The project was started under the administration of Mayor Perry D. Pickett, and completed under the administration of Mayor J. W. McMillen. Throughout the entire job, the city was represented by W. H. Oswalt, City Manager, J. M. Orman, Director of Public Works and Henry E. Nunn, Water Engineer. The author's firm was represented by Horace L. Smith, Resident Engineer and A. C. Bowden, Design Engineer. The contractors involved are listed in the first part of this article.

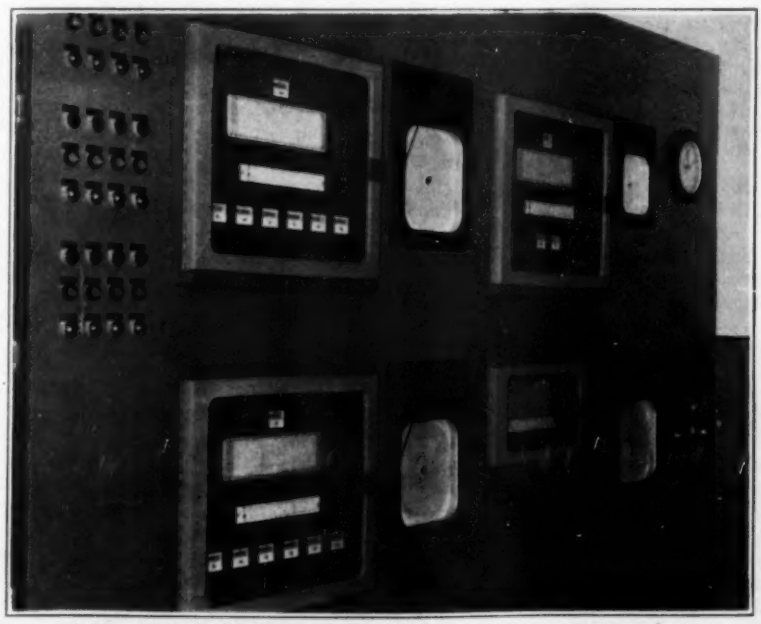


Fig.6—INSTRUMENT PANEL providing chart records and signal lights

Water Works Management

Comparing water utility management and operation under private ownership and a Municipal Authority

By JOHN H. LONG, Mgr., Gettysburg Municipal Authority, Gettysburg, Pa.

THE term "Municipal Authority" according to *The Municipality Authorities Act of 1945*, as amended, shall mean a "body or board authorized by law of the Commonwealth of Pennsylvania to enact ordinances or adopt resolutions for a particular Municipality." The term "Municipality," in this definition, shall mean any county, city, borough, township, or school district of the Commonwealth of Pennsylvania. A "Private Company" is one removed or retired from public view, owned by individual stockholders and controlled by the stockholders themselves, holding companies, or otherwise. With this in mind, we will try to compare a privately owned with an authority managed water works system. We will place special emphasis upon the financial rehabilitation of each, since financing would appear to be the greatest point of contrast between the two organizations.

The greatest problem facing us as individuals, companies, or municipal authorities today is taxation. This is one reason why municipal authorities are fast becoming a by-word in water works operations, schools, building maintenance, community centers, airports, and state functions.

Differences in Financing

We know that authorities are financed through the sale of municipal authority bonds, the interest on which is tax exempt. Income from the bonds, including any profits made on the sale thereof, shall at all times be free of taxation within the state. Naturally, this makes it possible for these bonds to be sold at interest rates lower than those which could be obtained by private companies. Another probable reason why interest rates are lower is because the authority bonds are looked upon as coming from a governmental body. With some exceptions, we have found through experience that water authorities can sell their bonds at an interest rate lower than any other authority today. Note, however, that there *are* some with exceptions.

In contrast to the municipal authority, the private company is owned by one or more stockholders who have invested their money in water utility stock with a reasonable assurance that dividends will be received periodically. Since the dividends are taxable, this fact will have some bearing upon the different bond interest rates applying to municipal authorities and to private water companies at times of financing or re-financing.

State and Federal Taxes

Although a municipal authority is exempt from the payment of federal excise taxes, it must pay all state taxes. It has been considered that the Commonwealth of Pennsylvania should exempt municipal authorities from some taxes. The *property* of a municipal authority and of a privately owned water company in the State of Pennsylvania is exempt from taxation and assessments if used for commerce, improvement of health and living conditions. Federal taxes which authorities do not pay include gasoline, oil, telephone, tires and many other items which amount to a considerable sum of money during the course of a year.

Social Security Tax now is optional for municipal authorities due to recent amendments by Congress. Many authorities recently have applied for and received permission to pay Federal Old Age Benefits on their employees. Private companies have complied with this law since its inception and all authorities will soon pay this tax, if only to keep in line with industrial competition.

A municipal authority is required to furnish only one yearly report to the Department of Internal Affairs, outlining briefly its type of operation, financial condition, and improvement programs. A privately owned water company must submit a similar report to the Department of Internal Affairs, in addition to furnishing State Tax returns, Federal Tax returns, and Public Utility Commission reports.

P.U.C. Jurisdiction

At the present time, the Public Utility Commission has no jurisdiction over municipal authorities with reference to increasing or decreasing rates, or to consumer requests for better service conditions. Those of us who are acquainted with privately owned operating companies are very much aware that the Public Utility Commission exercises strong control over the activities of these companies. We know that in order to increase rates in privately operated companies, statistical information must be prepared for the Commission; such as original cost studies, reproduction costs depreciation, and present book values (which may or may not have appraisals). The officers who are responsible for the operation of the utility must appear before the Commission to show reasons why such increases or decreases are required. In all cases of financing or re-financing, an appearance must be made before the Commission to state the reasons why it should be done.

Those who are acquainted with the operation of privately owned companies having a gross revenue exceeding one hundred thousand dollars, are aware that continuous property records are required by the P.U.C. Properties having gross revenue under one hundred thousand dollars are not required to prepare such records.

Any unsatisfactory service conditions may be brought to the attention of the Commission by individuals or by groups of consumers. In such cases the companies are required to show cause or reason why such conditions exist and, if they exist, what steps are being taken to eliminate them.

As was mentioned previously, a municipal authority is not required by law to comply with these requests. If a municipal authority feels that a rate should be changed, this can be accomplished by obtaining the approval of the consulting engineer for the authority and can be adopted by the governing board. Consumers or

groups of consumers may appeal actions of the board to the Common Pleas Court of the County. Further appeal, if necessary, must be taken to the Superior Court of the Commonwealth. This action may be followed for rate increases or decreases, service disorders or interruptions.

It can be seen from this comparison that a greater and more extensive system of record keeping is required for the privately owned companies than is required for a municipal authority. Naturally, the expense of maintaining such records is considerable.

During the past session of the Legislature in Harrisburg, Pa., numerous bills concerning municipal authorities and their connections with Public Utility Commissions were advanced. Some of these bills were designed to give the Commission control over municipal authorities as they now control privately owned companies. With but one or two exceptions this legislation did not come out of Committee; where these bills did come out of Committee, they were defeated on the floor of the Legislature. Only one bill did pass; that concerning the appointment authority of board members.

Management and Operation

Authorities frequently are confronted with management problems, and sometimes they employ the services of privately owned managing companies to solve their problems. Solving the management problem of an authority often is more expensive than solving the management problem of private companies; the reason is that many private companies are owned and operated by a holding company. The latter is large enough in size to utilize large contracts for the purchase of materials at a reduced price. All types of general insurance are cheaper with this type of operation. Group insurance plans are very much cheaper when several companies with a large number of employees can be placed under the same plan. An authority with one group of employees will definitely have a higher group insurance premium.

There is little difference between the actual operation of the two organizations insofar as service to the consumers is concerned. Authorities, like private companies, are liable for State and Borough street resurfacing charges. The one big difference between the two operations is that a municipal authority does not come under the jurisdiction of the Wage and Hour Law as it applies to private industry; however, many authorities comply with Wage and Hour Law regulations—particularly to the point of paying overtime to their employees.

It has been the author's experience that public relations are probably better, and the consumer more easily satisfied, in a community serviced by a municipal authority than in one serviced by a privately owned company. This condition is primarily due to the fact that an authority is looked upon as a Government Body, whereas a privately owned company is looked upon as a group of individuals who can change their rules and regulations to suit any particular occasion that might arise. We know that this is not completely true, because as previously mentioned the Public Utility Commission has control of these regulations.

Aside from these few items there is no difference in the operation of the two types of organizations. In each case, service must be given to consumers; in each case the same number of employees are required to provide this service. Material costs and operating expenses are the same. Many authorities originally were incorporated for the purpose of operating water systems but have since taken over the operation of the sewer system coming within its jurisdiction. Naturally this reduces the operating expenses of each system, since the two groups of employees can be bonded together as one. Office and administration expenses may also be reduced in the process.

This discussion is intended to emphasize that neither a municipal authority nor a privately owned water company has advantages or disadvantages over the other. Rather, the author has endeavored to point up the differences between the two types. It is well known that our country could not have progressed were it not for the encouragement of private enterprise. Likewise, it could not have grown without governmental bodies, from our Executive branches down through the lowest form of governmental agency.

Dr. Black to Head Florida's Bureau of Water Research

Dr. A. P. Black has been appointed to head a program for continuing research in Florida's vast water resources at the University of Florida beginning July 1, 1955, Acting President John S. Allen announced recently.

The continuing study to be established as the University of Florida Bureau of Water Research has been approved by the State Board of Control, and details of operation will be planned in the next few months. Dr. Black will relinquish his duties as head of the Department of Chemistry to direct the research of the new bureau next year.

The Bureau will be established as an adjunct of the College of Arts and Sciences, but will utilize the facilities of all University departments now offering training and research in water chemistry and related subjects. Chemical engineering in the College of Engineering will be correlated with the work of the bureau under present plans.

Problems that will come to the attention of the Bureau immediately upon its establishment include: adequate data on quantity and source of water in the state; additional information on the chemical quality and factors affecting the recharge of water in the Florida peninsula; factors affecting surface and ground water pollution; new and improved analysis; and others.

The new bureau will cooperate with all state and federal agencies in its study of water problems, and according to officials "may well act as a clearing house on all water problems."

Florida's vast water resources include thousands of surface lakes, rivers and springs as well as a vast network of ground water, and the systematic accumulation of data from these many resources will be the prime objective of the new bureau.

Pennsylvania Sewage Plant Needs Triple Capacity

Bids totalling $792,773.00 have been awarded by the Pennsylvania townships of Radnor, Haverford and Marple in Delaware County for the enlargement of their jointly owned and operated sewage treatment plant. The plant now provides complete treatment of sewage. The additions to be built will increase the capacity from 1,200,000 gallons a day to 3,600,000 gallons a day. The enlargement is made necessary by the great growth throughout the area.

Fig. 1—MICROSTRAINER operating in effluent channel at Baltimore's Back River treatment plant

Operating a Sewage Microstrainer

Results at Baltimore are comparable to the removal of solids accomplished by mechanically cleaned humus tanks

by C. E. KEEFER, Deputy Sewerage Engr., Bureau of Sewers, Baltimore, Md.

VARIOUS DESIGNS of fine screens have long been in use at sewage treatment plants to reduce the suspended solids content of raw sewage. They have also been employed at several plants to remove suspended solids from settled sewage, in order to prevent the clogging of trickling filter nozzles.

Recently, fine screens have been used to remove suspended solids from the effluent from secondary settling tanks following trickling filters. A small experimental drum screen, called a microstrainer, was first installed at the Luton sewage treatment works in England to treat humus tank effluent. This screen* proved capable of reducing the suspended solids content of the effluent by 61 to 73 per cent, and the biochemical oxygen demand by 31 to 46 per cent.

It was considered desirable to conduct experiments with a microstrainer at Baltimore's Back River sewage treatment works, and Infilco, Inc., loaned the necessary equipment to the city.

*See: (1) Pettet, A. E. J., Collett, W. F. and Summers, T. H., "Mechanical Filtration of Sewage Effluents." Jour. and Proc. Inst. of Sew. Purif., Par. 4, p. 399 (1949) and
(2) Dept. of Water Pollution Research Board (England) p. 24 (1949).

The Installation Described

The device (illustrated in Fig. 1) was operated by a 3-h.p. electric motor through worm and spur gears. The fine screen was a cylinder 2 ft. 6-in. in diameter by 2 ft. 3-in. long supported on a gunmetal framework. Specially woven stainless-steel wire fabric (Fig. 2), constitutes the microstrainer. The fabric used in our tests contained 75,000 apertures per square inch, each formed as a triangle with curved sides, and each being 35 microns long. The screen was supported horizontally on its axis by two corrosion-resisting bearings, and was submerged to a depth of 1 ft. 9 in.

The down-stream end of the screen was closed and was equipped with an axial roller-bearing. The up-stream end was provided with a spoked ring, supported at the drum axis by a trunion bearing. Sewage entered the interior of the screen through the opening between the spoked ring and the radial spokes. The outer periphery of the inlet end of the screen rotated in a closely fitting stationary ring of metal, which normally is built into the division wall between the unscreened sewage compartment and the chamber containing the screen and its effluent. The annular space between the outer surface of the inlet end of the screen and the stationary ring was sealed by a copper band faced with thick felt to prevent the passage of unscreened sewage. After entering the interior of the screen, the sewage flowed radially outward through the screening fabric.

Microstrainer Tests

Suspended immediately above the screen was a ¾-in. horizontal water pipe, equipped with spray nozzles for cleaning the screen. Tap water under a pressure of approximately 40 lb. per sq. in. was used for flushing purposes. As the suspended solids were caught on the inner surface of the screening fabric and lifted out of the sewage, they were cleaned off the fabric by the spray of flushing water into a waste trough inside the drum.

The screen was tested when filtering (a) humus tank effluent, and (b) trickling filter effluent. Results were inconclusive when screening humus tank effluent, as difficulties were encountered in securing an adequate supply of water for cleaning purposes; therefore, the percentage of removals of suspended solids and 5-day B.O.D. are not reported.

The screen was used to treat trickling filter effluent from February 25, 1953, to July 17, 1953. The quantity of sewage treated was determined by a V-notch weir used in conjunction with a hook gauge, which was read to one-thousandth of a foot. Samples of unscreened and screened sewage were collected hourly and composited every 4, 8 or 24 hr. In general, samples were collected 5 days each week except on Saturdays and Sundays. From February 25 to May 15 the tests were of a preliminary nature. During this period the removal of suspended solids and 5-day B.O.D. averaged approximately 65 and 41 per cent, respectively.

Filter Effluent Removals

From May 18 to July 17, inclusive, tests were conducted with the screen rotating at speeds of 30, 40 and 50 sec. per rev. Results are given in Table 1. The speed of rotation had little effect on the percentage removal of suspended solids.

The removal averaged 56.1 per cent when the screen operated at 30 sec. per rev., and 58.9 per cent when the speed was 50 sec. per rev. The removal of 5-day B.O.D. averaged 38.4 per cent.

Fig. 2—WIRE FABRIC shown in isometric drawing is stainless steel

The quantity of sewage treated by the screen varied from 17.5 to 42 gal. per min. In general, the flow through the screen was greatest when it was operated at 50 sec. per rev.

Discussion and Conclusions

The average removal of suspended solids from the trickling filter effluent was somewhat better than 55 per cent. This performance is comparable with that of properly operated humus tanks. Where land is at a premium or where there may be objections to humus tanks, micro-straining equipment may be preferable. Although the screen was built of non-corrosive metals and seemed to be well made, the duration of the tests were too short to evaluate its durability and useful life.

The extent to which screens of this design will eventually be used to treat either trickling-filter effluent or the effluent from humus tanks will depend to a considerable extent upon how their first cost compares with that of humus tanks. The tests made in Baltimore indicated that the suspended solid content in the effluent from the screen was comparable with the effluent produced by the four mechanically cleaned humus tanks at the Back River plant.

Table 1
Performance of Microstrainer
Screening Trickling Filter Effluent

Date	Sewage Screened g.p.m.	Suspended Solids Influent p.p.m.	Suspended Solids Effluent p.p.m.	Suspended Solids Removal, %	5-day B.O.D. Influent p.p.m.	5-day B.O.D. Effluent p.p.m.	5-day B.O.D. Removal, %
		Drum Speed:	30 sec. per rev.				
May 18	17.5	56	25	55.4			
May 19	18.0	70	35	50.0			
May 20	18.5	60	25	58.3			
May 21	20.0	72	7	90.3			
May 25	18.0	70	30	57.1			
May 26	19.5	119	38	68.1			
May 27	20.0	112	41	63.4			
May 28	20.0	65	30	53.8			
June 1	17.5	26	15	42.3			
June 3	18.0	53	5	90.6			
June 4	18.0	62	34	45.2			
June 5	18.0	68	43	36.8	46	32	30.4
June 8	28.0	43	19	55.8			
June 9	28.0	34	27	20.6			
June 10	28.0	117	53	54.7			
June 11	29.0	73	33	54.8	41	26	36.6
Average				56.1			
		Drum Speed:	40 sec. per rev.				
June 15	28.5	88	41	53.4			
June 16	29.0	78	38	51.3			
June 17	30.0	69	29	58.0			
June 18	29.0	93	36	61.3	39	21	46.1
June 23	30.0	29	10	65.5			
June 24	29.5	34	18	47.1			
June 25	—	74	34	54.1			
June 30	—	48	30	37.5	41	30	27.5
Average				53.5			
		Drum Speed:	50 sec. per rev.				
July 1	—	47	2	95.7			
July 2	—	96	43	55.2			
July 3	—	65	20	69.2			
July 4	—	60	20	66.7	39	21	46.1
July 8	40.0	35	17	51.4			
July 9	40.0	51	31	39.2			
July 10	40.0	65	26	60.0			
July 14	42.0	70	27	61.4			
July 15	41.0	67	18	73.1			
July 16	41.0	47	17	63.8			
July 17	42.0	54	20	63.0	41	23	43.9
Average				58.9			

Acknowledgements

The Back River sewage-treatment works is under the supervision of P. L. Holland, director, Department of Public Works, and John J. Hunt, sewerage engineer. Dr. Abel Wolman is consultant to the Department of Public Works.

W&SW

Industrial Waste Instrumentation for Measurement and Control

A summary of practical applications and problems

by **JOHN J. BAFFA, *Consulting Engineer***
New York, N. Y.

PRESENT design practice in the field of industrial waste treatment in large degree utilizes instrumentation for measurement and control. Applications of instruments are found in all methods of wastes disposal, including discharge to municipal sewer systems, or to streams, or to ground waters. The industry may discharge wastes after complete treatment, or partial treatment, or no treatment.

Waste flows, fluid flows, liquid levels, temperatures and waste and fluid quality characteristics require measurement in order to:

(a) Obtain data upon which to base the design of collection, treatment and disposal facilities.

(b) Provide for operational control of treatment processes.

(c) Monitor waste-contributing processes, treatment plant influents and effluents, and receiving waters.

Mr. Baffa's paper was presented at the First Conference on Instrumentation, Manhattan College, New York, and is here printed with permission.

The use of instruments for these purposes also provides data for improvement of existing plants, for future design, for the dissemination of records, and for the stimulation of research.

Flow and Quality Variations

Industrial waste discharges generally are characterized by extreme variability in flow and quality. To measure these characteristics or to control them *manually* is, in many instances, humanly impossible; it certainly is subject to human errors, or dangerous, or expensive. Instrumentation provides the necessary tools to measure and control variations, eliminate human factors and save expense, all subject to the limits of present day knowledge, practicability and economy.

Industrial Waste Surveys

Instrumentation applications are especially useful in obtaining the data necessary to solve an industrial waste disposal problem. These applications include field measurements of waste flow and quality, quality measurements made in the laboratory, automatic recording of pilot plant flows, and pilot plant influent and effluent quality. In many instances, some of these measurements are necessary not only for the waste discharges but also for the receiving waters or municipal facilities.

The measurement of flow usually is accomplished by installation of a primary device such as a weir,

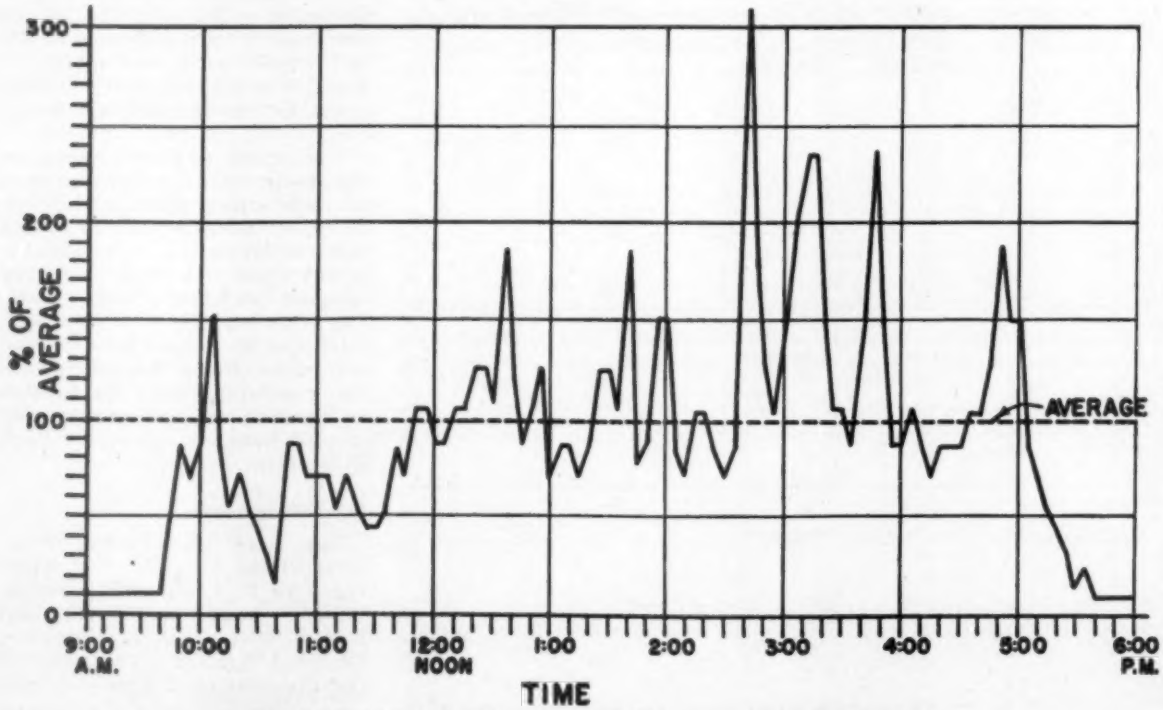


Fig. 1—ONE-DAY PATTERN of industrial waste flow for a cosmetic manufacturing plant.

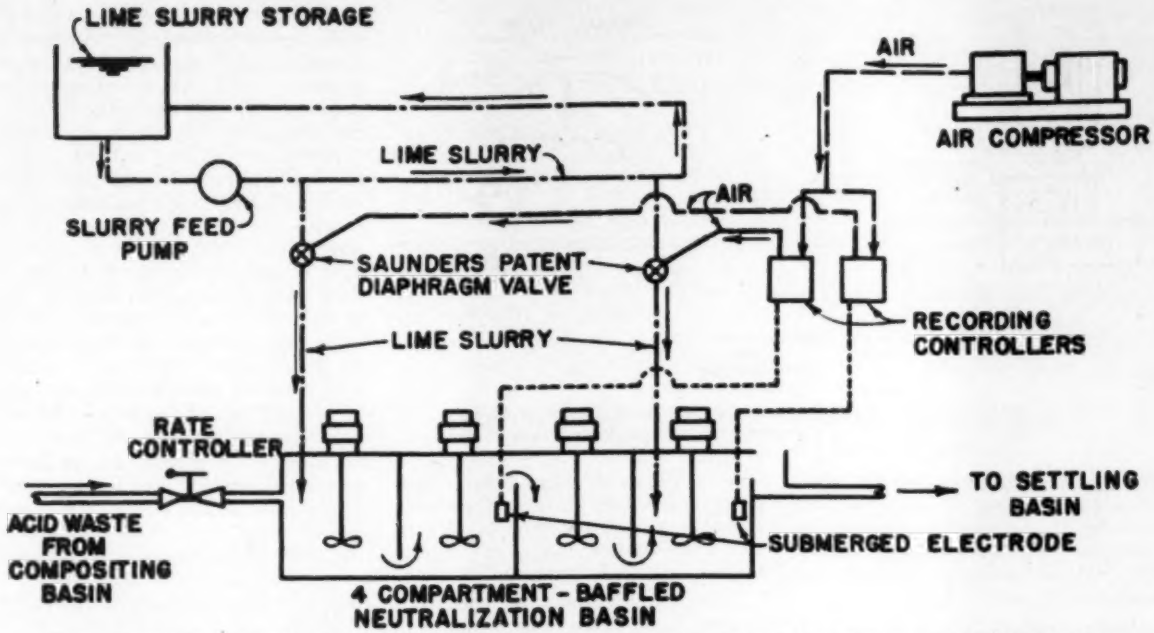


Fig. 2—NEUTRALIZATION of acid wastes. Scheme for automatically proportioning chemical solution feed on basis of pH value.

orifice, Parshall flume, Venturi tube, positive displacement meter, or Pitot tube. Automatic recording of the flow, for a length of time sufficient to establish its peculiarities, provides basic design data. In some instances, several flow measuring units may be installed to measure flows from several of the manufacturing processes in the same plant, in order to permit calculation of component quality considerations. In this manner, leakage and losses may be revealed, isolated and corrected to reduce the volume of flow to be treated, and to increase manufacturing efficiency. Flow measurements also provide the necessary data or actuating means for manual or automatic sample compositing. Fig. 1 shows a waste flow pattern over a one-day period for a plant manufacturing cosmetics. The pattern is best described as being extremely variable over a wide range, as is characteristic of most industrial waste flows.

Quality determinations during the survey period may involve a number of instrument applications. These include recording pH meters and conductivity meters, recording temperature gages, turbidimeters, photometers and oxidation-reduction measuring devices.

Treatment Process Control

When complete treatment of waste is practicable, the use of instruments and control systems finds wide application to provide both uniformity of effluent and maximum operating efficiency.

Instruments are available to facilitate manual control of batch and of continuous waste treatment processes, and to provide automatic control of both batch and continuous flow processes.

Using flow meter and pH meter records which show a definite pattern, the operator can manually set chemical feed quantities as required. As a further step toward automatic control, chemical feed settings may be changed automatically by time clock controls. Where widely variable conditions are encountered, or where considerable sensitivity of process is involved, then the automatic proportionment of chemical feed in accordance with pH, conductivity, or flow may be necessary.

The choice of instruments for any particular case depends upon the circumstances and economic factors involved and no general rules can be made.

Uniformity of effluent is important in many applications and can best be achieved by automatic proportioning of chemical feed, either according to flow or quality variations.

Operating efficiency, as a rule, is greatly increased by the application of automatic control to chemical proportioning. Manual labor costs are saved, human factors are eliminated, waste of chemicals through overdosage or possible corrosion through under-dosage are absent; and highly trained personnel, otherwise required to supervise manual operations, is left free for other tasks. Instrumentation applications providing for increased efficiency also include automatic flue gas sampling and automatic recording of conductivity or pH to indicate raw materials wastage.

Solution Feed Control

An example of proportioning chemical feed in accordance with quality variations is shown diagrammatically in Fig. 2. The application was made to neutralize an acid waste discharged from the manufacture of dyes. After compositing, a Simplex Valve and Meter Co. controller provided flow control to permit eight hour (1 shift) operation of neutralization facilities as well as to eliminate the flow variable. The basin dimensions chosen were based on reaction time determined in the laboratory, and the total volume was divided into four over-and-under type baffled compartments, each provided with a stirrer.

Two-point control was chosen in the interests of efficient reagent usage and maximum effluent uniformity, and also to prevent undesirable aftereffects in the receiving stream. Lime slurry was applied with continuous circulation, feed point take-offs being through Saunders Patent diaphragm valves pneumatically positioned. The recording controllers installed were Leeds and Northrup pneumatic controllers having proportional reset and rate ac-

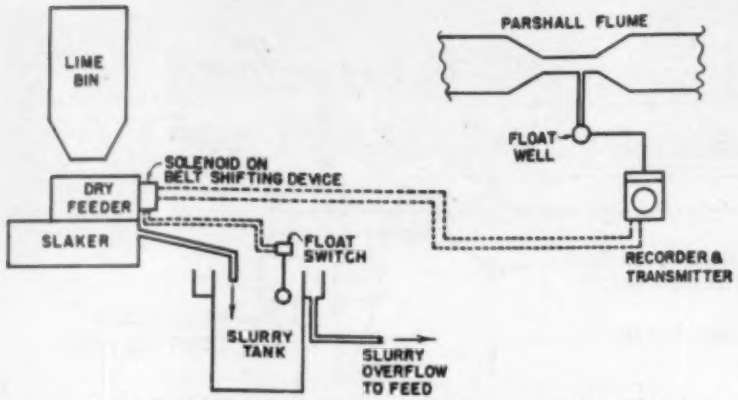


Fig. 3—COAGULATION of flue dust and waste. Scheme for dry feed control. Slaked lime is automatically proportioned on basis of waste flow.

tion. Immersion type pH electrode assemblies having plastic heads were installed in the locations shown. The electrode assembly includes measuring electrode, reference electrode and temperature compensator.

With changes in pH at the electrodes, the controller automatically increases or decreases slurry flow through positioning of the diaphragm valve. The amount of increase or decrease of slurry flow is proportional to the extent that pH deviates from control point setting, and to the length of time that the deviation exists. Operation for several months indicates that with an influent pH varying from 3.0 to 4.0 the desired effluent pH of 6.0 can be maintained with little if any variation.

Dry Feed Control

In another application, shown diagrammatically in Fig. 3, lime feed is proportioned in accordance with flow using a Parshall Flume as the primary device. In this instance, flow changes are gradual, and quality of waste is relatively uniform. The recorder and transmitter were supplied by Builders Iron Foundry and the dry feeder by Omega Machine Co. The connection from the primary device to the transmitter is hydraulic, thence electrical impulses signal the solenoid at the dry feeder. The solenoid positions the belt-shifting device controlling feed rate. The float switch in the slurry tank is a safety precaution; it stops the feeder and the slaker discharge to the slurry tank if slurry lines clog and tank fill above normal level. Feeder and slaker will start when tank level recedes to normal.

Where flow changes are abrupt, and quicker response to flow changes is required, this same system is applicable except that belt shifting device would be eliminated and transmitter impulses would actuate a control valve on the slurry tank outlet, with slaker rate set slightly higher than lime demand.

Other applications of automatic control to industrial waste treatment plants include automatic control for digestion tank temperature and gas pressure, sludge conditioning pH, and operation of automatic bar screen and tank mechanism.

Monitoring Services

The monitoring function of instrumentation is of extreme importance for the following purposes:

a) To provide operator and community safety.

b) To safeguard receiving streams or municipal systems.

c) To provide a measured basis for municipal or sewer authority charges.

d) To provide records indicating that stream regulations have been met.

Instrumentation for safety purposes includes, automatic gas analysis for methane and inflammable or toxic gases, automatic recording of chlorine residual and detection of radio-active substances. Automatic recording of flow, effluent pH, conductivity and oxidation-reduction potential provide measures of effluent character. In all cases, alarm systems can be provided for instantaneous warning of treatment process failures, or manufacturing process failures, or losses which might affect treatment or disposal. The stream or receiving system is thus safeguarded. Instruments also protect an industry against charges of having discharged pollutants such as those which may cause injury. The study of recorded data can lead to elimination of waste and to improvement of process efficiency.

Modern developments such as municipal regulations which affect waste discharges to sewers, and sewer rental laws, have broadened the field of instrumentation application. Municipal regulations control the quantity and quality of waste discharges for the protection of sewers and of treatment plants (against deterioration and process upsets). In many instances, charges are made for handling industrial wastes. However, industries frequently find that disposal to municipal sewer systems provides an economical solution to their waste problems.

Fig. 4 illustrates an example of facilities for the controlled discharge of industrial waste, without pretreatment, to a municipal sewer system. The purpose of the design is to discharge a maximum of the waste during time of minimum sewage flow to a municipal sewage treatment plant. No pretreatment of waste is required as the waste forms no sludge in the holding tank. The rate controller is Builders Iron Foundry Model RCB. At a predetermined time set on the time clock, the rate controller is automatically opened to a previously set rate by the pneumatic control

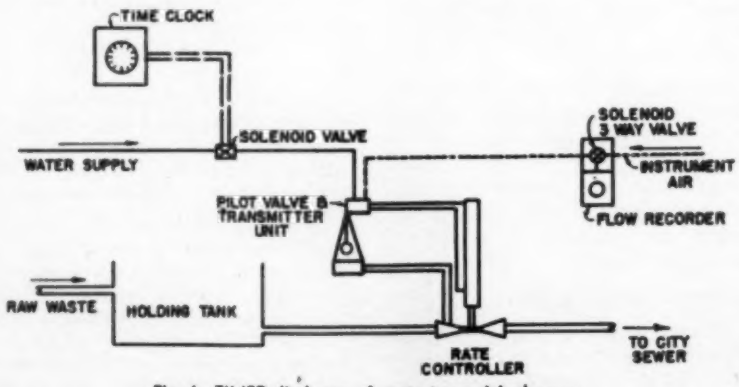


Fig. 4—TIMED discharge of waste to municipal sewer. Assures maximum waste flow during minimum sewage flow.

system. After a pre-set time interval, the controller is closed.

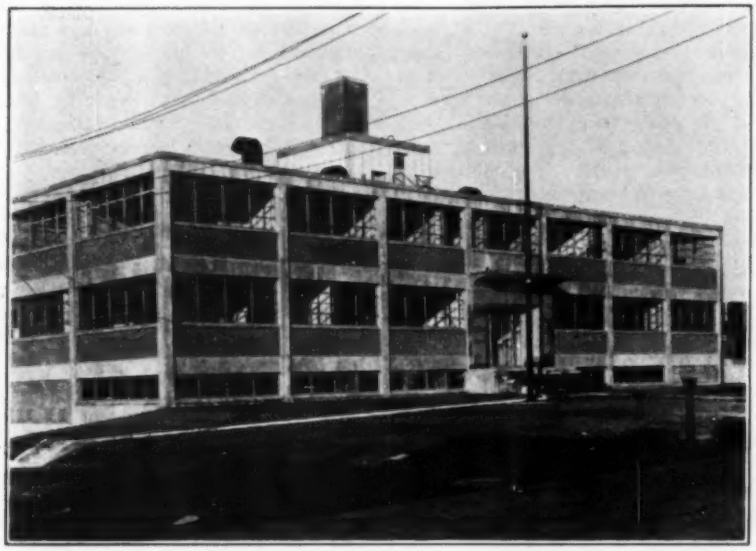
Problems in Instrumentation

Applications of instrumentation to industrial waste treatment involve many problems which present a challenge both to the sanitary engineer and to the instrument manufacturer.

Primary devices for flow measurement and for determining hydraulic transmission levels very often must handle liquids high in solids; accordingly, consideration must be given to that characteristic and provision must be made for purging. Solids and grease also can plug sample lines, coat or poison electrodes, and weigh down floats. The handling of corrosive liquids and fumes requires suitable choice of resistant materials.

Specific problems are involved in sensitivity of control over a wide range of flow or of pH values. Special consideration must be given to the selection of sampling points, since these are subject to difficulties occasioned by short circuiting through tanks, and by the addition of reagents in dead spots.

The sanitary engineer should be familiar with instrumentation developments, the principles of instrument operation and applications. He should be able to define a given problem to the instrument specialist, basing his specifications on the legal, hydraulic, chemical and biological requirements which apply.



Lawrence Experiment Station Inspected by N.E.W.W.A. Members

The new Lawrence Experiment Station of the Massachusetts Dept. of Public Health, and the Water Filtration Plant of the City of Lawrence were inspected by members of the N.E.W.W.A. at the Association's meeting on May 20, 1954. Luncheon and technical sessions were held at the Andover Country Club.

Joseph C. McCarthy, Chief, gave visitors a "grand tour" of the new building. The staff of specialists showed justifiable pride in the new facilities, new working space, and new problems under investigation. Two studies proved of special interest: one, on use of the antibiotic aureomycin for disinfection of shellfish; and another on the automatic measurement of radioactivity in water samples.

"A Long Range Plan for Andover Water Supply" was described by George A. Sampson, of Weston and Sampson, Boston, Mass. The plan involves raising the level of the supply pond by two feet, increasing the size of the force main (which will provide greater pumping capacity), and constructing an additional reservoir on newly acquired land.

"Operating Experience with Chlorine Dioxide" was reported by Joseph C. Derby, Chief Chemist, Lawrence Water Filtration Plant. This plant serves a population of 105,000—average consumption being 7.3 mgd. Raw water, from the Merrimack River, is treated by coagulation, filtration, post-aeration, and post-chlorine dioxide application. Since experimental studies of chlorine dioxide began in 1951, this treatment has been adopted to local conditions with very satisfactory results.

Following the one-day conference of the N.E.W.W.A. at Rye Beach, N.H., on June 17th, there will be no meetings until the Annual Convention at Poland Spring House, Maine, October 3 to 6, 1954.

Pollution Scares Buyers of Factory Sites

It is reported that more municipal sewage works are needed to solve a sad situation that now exists in Tennessee. The state is losing new industries because of pollution in its streams according to Harold Miller, Executive-Director of the Tennessee Planning Commission.

Mr. Miller said that among other places the 150 river miles between Knoxville and Kingsport offer "unparalleled sites" for industry. "I have shown these factory sites to many manufacturers and everything was just rosy until the analysis of the river water comes back", Miller said.

New Sewage Plant for Steubenville, Ohio

Start of construction of a sewage treatment plant at Steubenville, Ohio, marks another important step forward in the pollution-control campaign being directed by the eight-state Ohio River Valley Water Sanitation Commission. The disposal works, estimated to cost $2,500,000, will treat the sewage from a population of some 36,000 in compliance with requirements of the Ohio Water Pollution Control Board.

Removal of Radioactivity from Water by Clay

A recent report by William J. Lacy, Army Engineers' Research and Development Laboratory, Ft. Belvoir, Va., reveals that montmorillonite clay can be used to make contaminated water drinkable, usually within a day.

The clay is found in large quantities in Arizona and Mississippi, and may be able to treat a contaminated water supply after an atomic attack.

This special clay exhibits properties analogous to those shown by zeolites and synthetic ion exchange resins.

The B.O.D.-O.C.D. Relationship in a Treated Industrial Effluent

Development and application of an "Efficiency Factor"

by **SUMNER KAUFMAN**, *Sanitary Chemist, Lederle Laboratories Division, American Cyanamid Co., Pearl River, N.Y.*

THE application of chemical procedures to the determination of organic material in sewage and industrial wastes has been a subject of interest to the sanitary field for many years. More and more frequently, this increased attention is indicated by references in the literature to the advantages and disadvantages of these chemical methods. It has been the somewhat dogmatic acceptance of the B.O.D. test as a primary standard which has kept chemical procedures from finding their proper place as important and useful tools for process and investigational work in the wastes laboratory. However, the inherent limitations of the B.O.D. test, especially as applied to industrial wastes, has given impetus to the search for other means of evaluation.

Review of the Relationship Between B.O.D. and C.O.D.

As stated by Moore and Ruchhoft[1], chemical oxidation and biochemical oxidation involve separate and not necessarily comparable reactions. Determinations using the distinct procedures may then measure different parameters. When the determination is applied to the waste treatment process further difficulties can arise, for in many cases the raw waste stream is not a pure one, but rather is a complex mixture of practically infinite variation usually undergoing dynamic change. If, however, the character of the raw waste does not fluctuate too greatly, a workable relation between the B.O.D. and the chemical method may be obtained and, when plotted statistically, will result in a useful regression curve.

Rhame[2] states that the "aim of oxygen demand work is to evaluate wastes in terms of their reaction on the dissolved oxygen of the receiving stream. To this end, any chemical oxygen consumed procedure must be calibrated against the biological oxygen demand of the waste being considered." To gain optimum value from the chemical method, therefore, some means of correlation or comparison with the B.O.D. is necessary. In cases of accidental spills of waste, poor housekeeping, or other abnormal operation in an industrial plant, such a relationship is of real value—since it may provide information in time for corrective measures to be applied. On the other hand, the B.O.D. test requires five days for securing comparable information, thus limiting its value as an operations control method.

Moore and Ruchhoft[1] reported on B.O.D.-chemical oxygen demand relationships existing at various points in a stream receiving effluent from a primary treatment plant. The authors showed that the difference in values between the two methods increased with distance from the effluent site and state "this is simply an increase in the biologically stable material which is readily oxidized chemically."

Hoover and Porges[3] found that under optimum conditions the process of biochemical oxidation converted soluble organic material completely to bacterial cell and volatile end products such as carbon dioxide. The organic material, in the form of protoplasmic cell tissue, undergoes an endogenous decomposition[6], but the speed of this reaction is much slower than that of the original oxidation. Whereas the B.O.D. of this cellular material is quite low, a high chemical oxygen demand is exerted, since chemical oxidizing agents cannot distinguish between biologically stable and unstable matter.

It appears then, that as natural stream purification takes place, the soluble organic material originally present in the sewage plant effluent undergoes conversion with a portion constantly being lost to the atmosphere as gaseous end products while the remainder is utilized by the organisms in the anabolism of cell protoplasm. This explains the gradual reduction in chemical oxygen demand with the concurrent rapid drop in B.O.D. as the distance from the point of discharge increases. If, instead of distance in miles, the sampling points along the stream were considered "per cent of treatment", then the relationship between chemical oxygen demand and B.O.D. becomes a function of the degree of treatment.

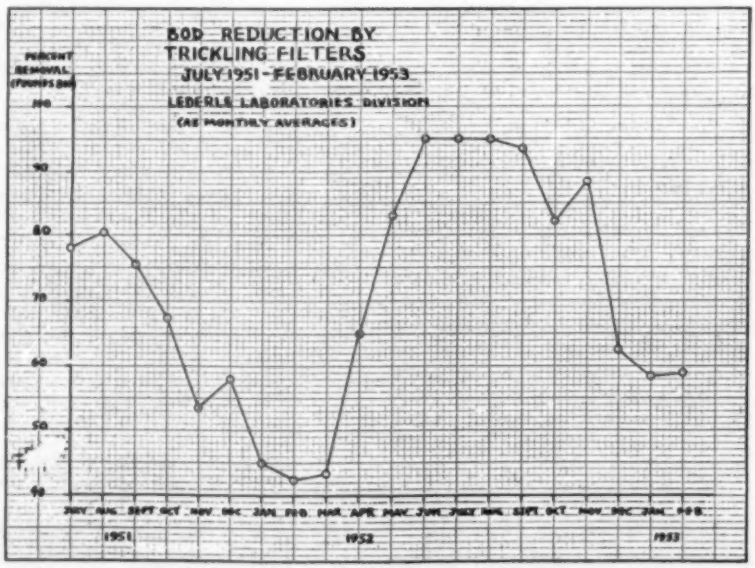


Fig. 1—EFFICIENCY variation in trickling filter operation on a monthly basis

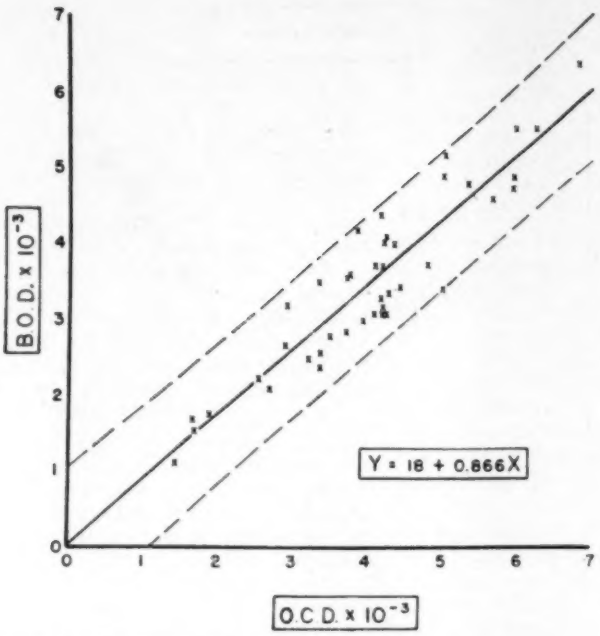


Fig. 2—(Left) REGRESSION of B.O.D. on O.C.D. in raw sewage.

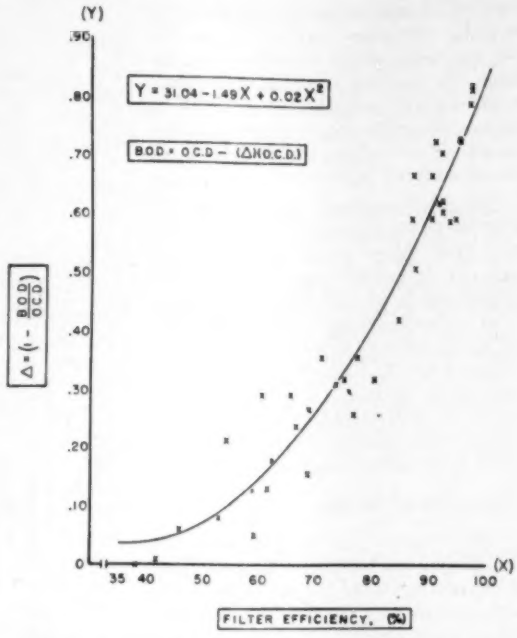


Fig. 3—(Right) Treatment effect on the B.O.D.—O.C.D. relationship.

Experimental Studies

At Lederle's Pearl River, N.Y., Plant, a need developed for a quick method of estimating the B.O.D. of raw waste from the manufacturing areas and also of the effluents from various treatment installations. The need prompted an investigation to determine whether a regression curve could be established as valid. This paper discusses some of the details of the work and the essential conclusions.

The B.O.D. technique employed was that given in Standard Methods for the Examination of Water and Sewage, 9th Edition. The chemical oxygen consumed technique was the Moore Dichromate Reflux Method[a]. In all cases cited, the expression O.C.D. is meant to indicate Oxygen Consumed by Dichromate, Moore Reflux Method.

Routinely, for a four month period, composite samples taken at various steps in the treatment process were set up for B.O.D. and O.C.D. determinations. Fig. 2 is the relationship of B.O.D. to O.C.D. for raw industrial waste. A high degree of correlation is evident despite the relative inconsistency of the chemical components of the waste. With this empirically derived expression the B.O.D. can now be estimated five days before it would normally be available, making possible corrective measures if these are indicated. It must be borne in mind that any relationship existing for raw waste does not necessarily hold for treated waste, and it is this aspect of correlation which prompted further study.

Trickling Filter Effluent

The efficiency of biochemical oxidation by trickling filters varies greatly at the Lederle plant, affected predominantly by temperature and loading. When an attempt was made to plot O.C.D. against B.O.D. directly for the filter effluents, it was immediately evident that a straight line correlation did not exist. This condition indicated the introduction of a new variable.

In line with Moore's stream observations, the effect of treatment was taken into consideration and the B.O.D./O.C.D. ratio was plotted against this as shown in Fig. 2. The abscissa is per cent efficiency in B.O.D. removal and the ordinate is a factor Δ . The value of Δ is the ratio effluent B.O.D /effluent O.C.D., subtracted from 1. The excellent correlation obtained substantiates the findings of Moore and indicates that the difference between B.O.D. and O.C.D. in a treated effluent is dependent upon and varies with the degree of treatment. In a given sample of treated effluent whose O.C.D. is known, the B.O.D. is seen to be determined by the extent of stabilization which has occurred.

Formula Developed

By application of the formula B.O.D. = O.C.D. — Δ O.C.D., a B.O.D. estimate can be made from an O.C.D. determination. In this case Δ is first taken from the graph (Fig. 3) using the treatment officiency of the previous week; experience here being that efficiency, while quite variable on a monthly basis (Fig. 1) is more gradual on a week-to-week basis. The O.C.D. value is then inserted in the formula and the B.O.D. value is calculated.

For example, on one particular day, a filter effluent O.C.D. was 1320 ppm. The efficiency of this installation during the previous week was 80 per cent. At this efficiency, Δ is found in Fig. 3 to be 0.42. Therefore, B.O.D. = 1320 — (0.42) 1320 = 765 ppm. Five days later the B.O.D., when actually determined, was found to be 725 ppm.

If the efficiency had been 92 per cent instead of 80 per cent, a Δ of 0.625 would be taken from Fig. 3. In this case B.O.D.=1320—0.625 (1320)=475 ppm. Below 45 per cent efficiency, where Δ becomes negligible, a straight line relationship similar to Fig. 2 seems evident, but lack of sufficient data makes confirmation of this impossible at present. Use of this procedure can materially reduce the number of routine B.O.D. determinations.

For large scale investigation studies, or in plants where treatment efficiency varies greatly from week to week, a curve similar to Fig. 4 may be used. This graph plots efficiency of treatment by B.O.D. against efficiency

by O.C.D. and is used to estimate the B.O.D. efficiency needed in securing Δ. This procedure eliminates the need for making B.O.D. determinations except as infrequent checks to assure that the characteristics of the waste have not varied from what may be considered normal.

As an example of this method, the O.C.D. of raw waste on a certain day was 2640 ppm, while that of a filter effluent was 530 ppm. The O.C.D. efficiency is therefore 80 per cent. The corresponding B.O.D. efficiency is found in Fig. 4 to be 91.5 per cent. From Fig. 3, Δ at this efficiency is found to be 0.63. In this example, B.O.D.=530÷0.63 (530)=196 ppm. The actual B.O.D., determined five days later, was found to be 195 ppm.

Discussion of Results

One reason for variation in the B.O.D./O.C.D. relationship of treated effluents has been cited; namely, the conversion of susceptible dissolved organic material to bacterial cell material. There is another consideration which became evident when volatile dissolved solids reductions were computed and compared with B.O.D. reductions (Table I). It was seen that while B.O.D. reductions up to 95 per cent were realized, the reduction in volatile dissolved solids (VDS) for the same period never exceeded 55 per cent. Whereas the average B.O.D. reduction for the year 1952 was 74.1 per cent, the corresponding reduction in VDS was 34.9 per cent.

This finding indicated that instead of complete utilization of dissolved organic matter as obtained by Hoover and Porges, the material present in Lederle waste was only partially utilized. It seems probable that decomposition of the complex organic substances produced stable breakdown products which prevented further catabolism to the ultimate end products of protoplasm and carbon dioxide. Under the existent conditions, the semi-oxidized organic breakdown

Table 1
B.O.D. and Volatile Dissolved Solids Reductions

Month	% BOD Removal	% VDS Removal
January	45.0	40.0
February	42.5	29.3
March	43.5	12.8
April	65.0	21.8
May	83.0	.....
June	95.0	.....
July	95.0	.....
August	95.0	49.5
September	93.2	52.3
October	82.0	37.2
November	88.1	45.5
December	62.5	25.0
Average	74.1	34.9

Monthly Averages for 1952. Industrial Wastes Treatment Plant, Lederle Laboratories Division, Pearl River, N.Y.

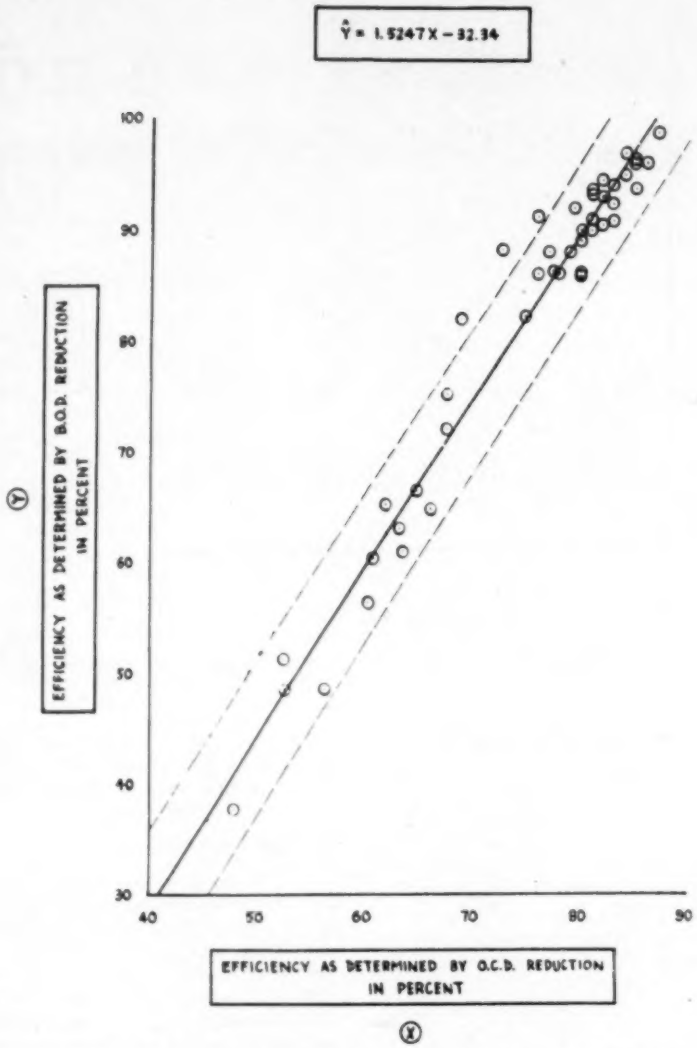


Fig. 4—FILTER efficiency as determined by B.O.D. reduction vs. O.C.D. reduction
Data used are weekly averages, November 1952 to May 1953.

products are unavailable to the organisms and effect no B.O.D.; these products can be oxidized by chemical agents, and so effect a demand when determined by O.C.D.

The presence and the concentration of stable intermediate products in a treated effluent are determined by the following conditions:

1. Chemical constituents of the raw waste
2. Temperature
3. Biological flora
4. Inhibitory substances in the waste, such as heavy metals, antibiotics, alkalis and acids.

A list of chemical constituents making up the organic fraction of a specific waste is without limit. Included are: (a) substances which can be easily oxidized biochemically, such as straight chain alcohols, sugars, aldehydes and ketones; (b) those more complex molecules which may be decomposed in part to leave a residual of stable products; and (c) that group of substances which defies biochemical breakdown under conditions that exist in normal operation of a sewage treatment plant. In this group are some of the ethanolamines, polyethylene glycols, and pyridine. It can be seen then that the extent of conversion of groups (a) and (b) will depend greatly upon the degree of treatment accorded.

The part played by temperature in biological metabolism is well known. A more complete utilization of organic matter will result in the presence of an active biota, than in the presence of one whose metabolism is substantially reduced because of low temperatures. One result of reduced metabolism is incomplete oxidation, a condition which affects the degree of

treatment and hence the B.O.D./O.C.D. relationship.

The filter biota, and the substances which regulate its growth play an important role in the biochemical breakdown of organic solids. An antibiotic or some other toxic substance, by inhibiting a certain group of microorganisms, may prevent the development of the complex system of biological life necessary for ultimate decomposition. The resulting unbalanced biological system, incapable of utilizing completely the food at hand, will then allow this material to pass unconverted through the process —and the B.O.D. reduction will be correspondingly low.

Since the conditions described are unique for each individual waste and treatment plant, it is obvious that any correlative B.O.D./O.C.D. relationship of treated effluents must be determined for the specific situation involved. It is necessary, therefore, that the curve be plotted empirically, based on the conditions that exist, with periodic checks to insure its accuracy.

Summary

A comparison was made between the biochemical oxygen demand and the dichromate oxygen consumed determination on raw industrial waste and treated effluent. A straight line regression derived for the former provides a useful tool for determining the quality of raw waste.

A new variable is seen to be present when correlation is sought for a treated effluent. If the B.O.D./O.C.D. ratio is plotted against degree of treatment, a curve results which resembles that found in natural stream purification. This makes B.O.D. estimation possible for treated material when the factor Δ, determined by treatment efficiency, and O.C.D. are inserted in the formula B.O.D.= O.C.D.—Δ O.C.D. One reason given for this relationship is the conversion of dissolved organic solids to cell protoplasm. A second reason is the incomplete utilization of organic solids; that is, the production of stable breakdown products resulting from the raw waste characteristics, microbial flora, temperature, and inhibitory substances.

The curve presented is not valid for all wastes, because factors governing it are determined by specific conditions which necessitate individual empirical determinations.

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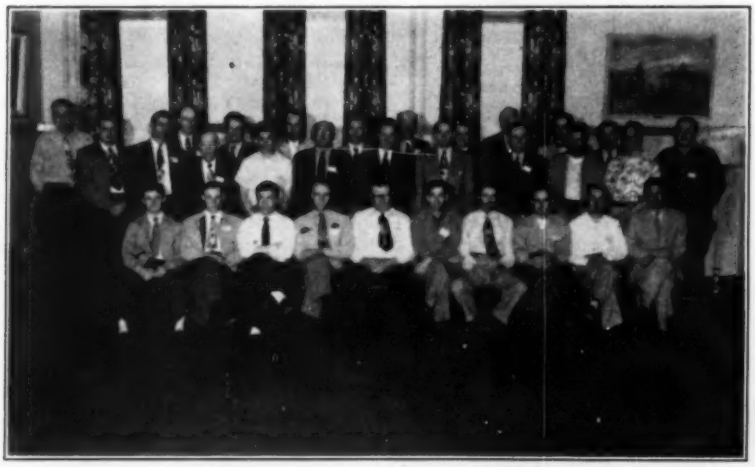


South Dakota Courses for Water and Sewage Operators

A short course for South Dakota waterworks operators was held at South Dakota State College last April. Total attendance at the short course was 42, including speakers and operators.

The waterworks operators short course was started in 1941, was discontinued during the war years and reinstated in 1952. Development of the short course is in cooperation with South Dakota State Department of Health, South Dakota Water and Sewage Works Conference and State College.

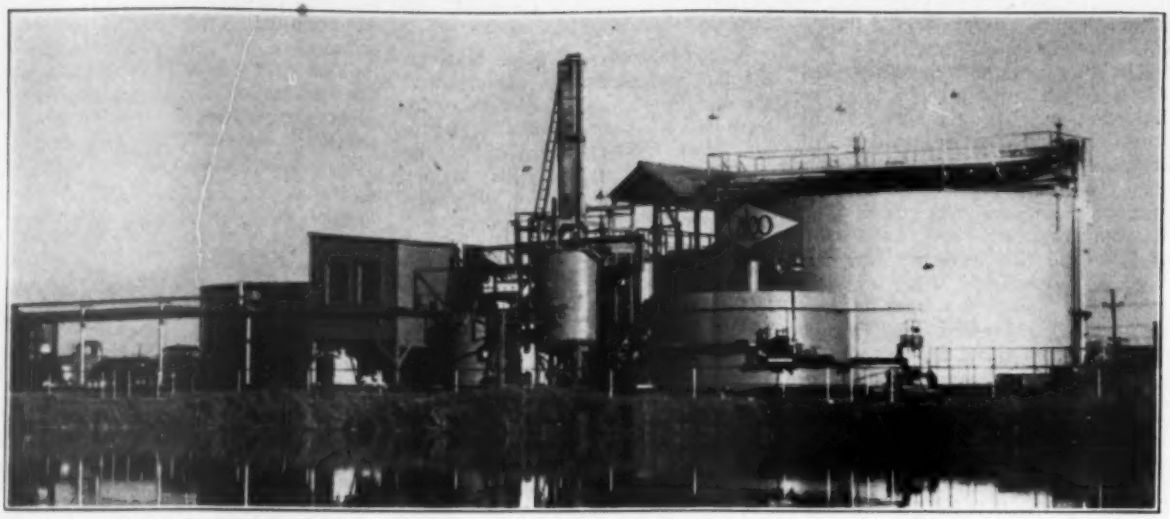
Starting in 1952 the short course was set up as a 2-day school on a biennial basis with waterworks courses to occur on the even years here at the college. Those in charge endeavor to arrange a program of general interest to all operators for the even year short course. The odd years are utilized by one-day meetings of specialized interest for the operators in various areas of the State under the direction of the State Department of Health. This was felt necessary due to the various degree of treatment given to the waters in different areas of the State. Under the plan, operators will be permitted to broaden their knowledge in the waterworks field. With voluntary certification of the operators now under consideration this practice will be of greatest importance.

To complete the short course program, a sewage works operators short course is held at the college on the odd years. A one-day meeting in different localities is held for sewage works operators in the even years.

Koppers Co. Operates Plant to Remove Phenols

The Ohio River Valley Water Sanitation Comm. has announced that an industrial-waste pollution control plant, costing one-half million dollars, has been placed in operation by the Koppers Company tar products division at Follansbee, West Virginia. Koppers officials have reported that this treatment plant is designed to reduce by more than 99 per cent the discharge of phenolic-type wastes. These wastes, produced by a number of industries, are a contributing factor to unpleasant taste conditions sometimes associated with Ohio River water.

Phenol-wastes control has been a matter of intensive study by the Ohio River Commission and its industry committees during the past few years. The Koppers Company installation, developed in connection with the West Virginia Water Commission, is the culmination of research work started six years ago.



PILOT PLANT trickling filter installation at American Cyanamid Co., Bound Brook, N.J.

Treating Organic Wastes on Experimental Trickling Filters

III. Operating Considerations

by **ALFRED B. CHERRY**, *Sanitary Engr., American Cyanamid Co., Bound Brook, N.J.*

THE general aspects and theories involved in pilot trickling filter design, and the considerations entailed in the design and construction of an actual unit were described in Parts 1 and 2 of this series. The purpose of Part 3 is to evaluate the operation of experimental trickling filters.

Great variability exists in the chemical and physical properties of liquid wastes which are produced by industrial plants. It is precisely because these differences do exist, that the data obtained from treatment of one industrial waste by trickling filters are not necessarily applicable to the treatment of another. Experimental studies can provide answers to the specific problems of a specific plant.

Planning Before Operation

The value of a pilot plant, however, is measured by the soundness and reliability of the information which it supplies. If the answers to waste treatment problems are not obtained because of unintelligent operation of a pilot plant, then all the time, money and effort expended in designing and constructing the experimental units will have been wasted. Although plant operation may be considered a less glamorous, prosaic facet of investigation, it must be obvious that the knowledge necessary for the fruitful completion of a pilot plant's purpose is acquired only by the operation of that plant.

What must be done to make a pilot filter "pay off"? As in other undertakings, a clear-cut picture should be developed beforehand—to define the nature of the starting materials and the goal being sought. This information guides the designing engineer in selecting needed equipment. In addition, it aids the operating engineer by enabling him to form a clearer concept of the difficulties he will encounter and problems he must overcome in the efficient operation of his plant.

Fig. 1—SAMPLING technique is important
At Bound Brook samples are collected each hour during a 24-hour day.

The Bound Brook Example

A typical example of this procedure was the program set up at the Bound Brook plant of American Cyanamid Co. prior to the installation of a trickling filter twenty feet in diameter and the auxiliary equipment now in operation. This pilot plant was installed to make possible the design and construction of large scale treatment facilities to reduce pollution of the receiving stream. A chemical analysis and field survey indicated the presence of large quantities of iron in a biologically oxidizable organic waste. On small rock filters, two feet in diameter, the prolific growth of bacteria which utilize iron in their metabolism produced a slime accumulation so dense as to render trickling filter treatment inoperative.

These observations indicated the necessity of including provision for removing carbon dioxide, so that the iron could be oxidized to its ferric state, prior to the application of the effluent to the rock bed. The operation of small-scale filters aided in the intelligent choice of pretreatment equipment, and provided analytical information to be evaluated during the operation of the larger experimental unit.

Laboratory Functions

Essential to the proper operation of any trickling filter is the establishment of adequate laboratory service. The exact analyses required depend upon the characteristics of the waste treated and upon the specific information that is needed. Examinations normally made of raw sewage and treated sewage effluents will be required. In a pilot plant, it is also desirable to investigate the degree of treatment accomplished at various depths in the rock bed.

Among the most useful tests are the following: biochemical oxygen demand; oxygen consumed by potassium permanganate or dichromate; dissolved oxygen; total and suspended solids, with their volatile fractions; nitrogen as organic nitrogen, ammonia, nitrites and nitrates; phosphates and other biological nutrients present in the influent; and the direct microscopic observation of biological flora and fauna present in the filter slime. Other special tests, such as that for total iron, can be made according to the particular needs of individual plants.

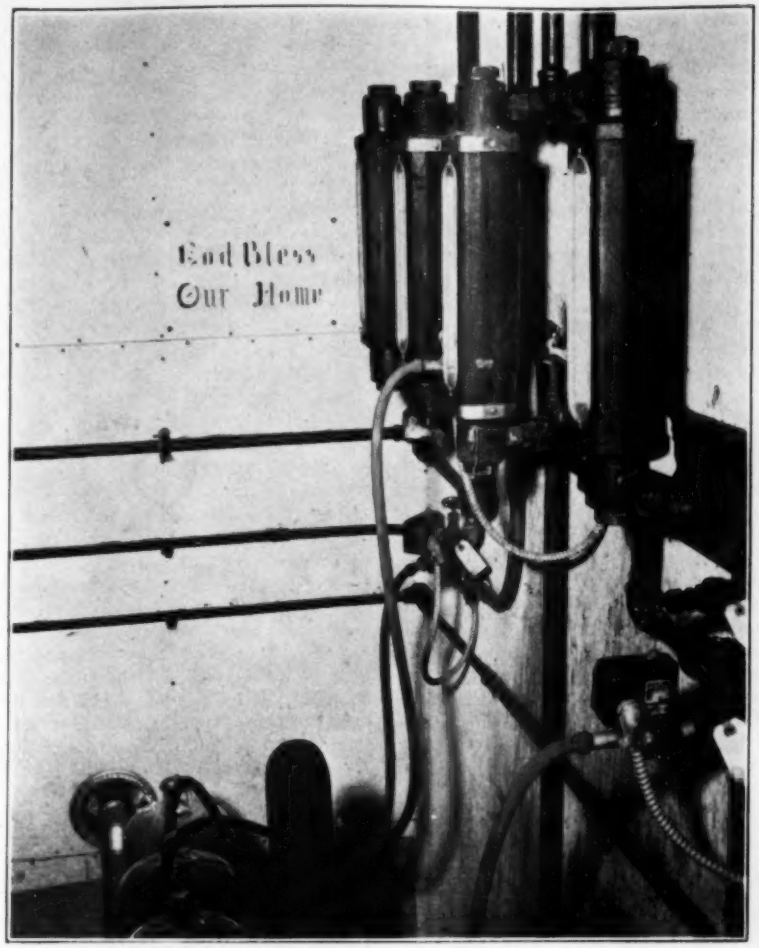


Fig. 2—AUTOMATIC sampling devices operated by an electric timer
At Pearl River samples are collected each one-half hour during a 24-hour day.

Three analysts at the Bound Brook plant and two at the Pearl River plant devote about forty per cent of their working time to pilot plant testing. In addition to compiling permanent records, they enter results on laboratory log sheets developed for that purpose, and copies of the data may be disseminated to interested parties. Plant operating information, such as flow, pH, temperature, settleable solids, and chemical additions is provided by the chart records of automatic instruments and by the operator's log sheet.

Operating Personnel

At the time experimental trickling filters were constructed, waste treatment facilities were in routine operation at the Pearl River and the Bound Brook plants. It was not necessary to engage additional employees to operate the pilot plants, as operators could be drawn from existing plant personnel. At Bound Brook, nine men are directly concerned with operation of the pilot units. Four men alternate each week and work rotating shifts under the direction of a general supervisor, who works the day shift, but is on emergency call twenty-four hours a day. The men carry "Laborer" classifications and their activities are guided by a sanitary engineer assigned to pilot plant study on a full-time basis. For a period of one month prior to the start of plant operation, the operating personnel received a detailed and intensive indoctrination course as to the mechanics and operations of the pilot plant under construction. Now, during the operation of the plant, they attend weekly discussions on the objectives of the pilot plant.

At Pearl River the personnel picture is similar in many respects. Four men classified as "Assistant Operators" carry out the duties involved in operating the large pilot plant. They work swing shifts under the direction of an "Operator," who, as in Bound Brook, works the day shift but remains on twenty-four hour emergency call. Pilot plant operations are carried out in addition to their regular operative actions. They received no formal class instruction prior to startup. Informal instruction in operation was given by the engineer in charge, and concurrent training is supplied whenever necessary while the plant is in service.

Union Contract Policies

The scope of the maintenance work that these men can do is determined strictly by union contract and plant policies. At Pearl River, the pilot plant men are permitted, for example, to do little more than clean and regulate pilot plant equipment, prime pumps, and make other minor adjustments. All other maintenance, such as oiling, packing, piping changes and repairs must be done by the plant's Maintenance Department, which supplies round-the-clock coverage in all phases.

At Bound Brook, the pilot plant men are permitted to do all maintenance and repair work that does not entail major alterations, in addition

to the actual manipulation of pilot plant equipment. The larger jobs are handled by the Area Maintenance crews, who also supply twenty-four hour coverage.

Sampling Practices

In a preceding section it was stated that the value of a pilot plant is measured by the soundness and reliability of the data it supplies. It must be realized that the data obtained is only as good as the samples sent for analysis. For this reason, great emphasis must be placed upon collecting composite representative samples, and upon proper sampling techniques. During a twenty-four hour day samples are taken by hand each hour at Bound Brook, Fig. 1, and every half hour by the use of automatic sampling devices at Pearl River, Fig. 2.

Automatic sampling devices at Pearl River (Fig. 2) are attached to the raw feed and filter recirculation pumps. The devices are operated by an automatic electric timer, geared to open solenoid-operated valves once every half hour. The volume of sample collected is controlled with a valve. The samples are composited and refrigerated as soon as is practical, in order to retard biological activity in the bottle.

Instantaneous tests, such as pH, temperature and dissolved oxygen are made as often as desired. Other tests are usually made on a daily basis, depending upon the work schedule in the laboratory. During a normal five-day work week, samples for biochemical oxygen demand can be set up only on Wednesday, Thursday and Friday. Since the B.O.D. determination requires a five-day incubation period, these are the only days which permit tests of samples after the incubation period and during the working week.

As the analytical data and operating results accumulate, they are compiled by a competent individual who is able to form sound and logical conclusions from them. The conclusions are used as an aid to the daily operation of the plant; they provide a weekly, monthly, and quarterly basis (in retrospect) for determining the overall operating picture of various units. A minimum of one month's time elapses before any set of conditions in a single test is changed. This period permits sufficient time for bacteria to adjust completely to environmental change, and then to produce consistent results. The pilot plant as a whole should be operated for at least 12 to 15 months before any complete picture can be attempted.

The responsibility for control of waste treatment differs at various plants. Generally it is assigned to an individual in the direct line of command. The technical data and interpretations from the pilot plant operation are presented to him for consideration and for report to Management. It is in this way that pilot plant results and operational data guide in making decisions which affect the industrial plant and the community in which it is located.

History shows that the Dark Ages came to an end because Galileo introduced the experimental approach as an aid to pure reasoning, thus ushering in a great period of advancement through the use of clinical evidence. This is the theme on which the operation of pilot plants is based. By the use of pilot plants, we seek to better understand problems of waste treatment and, thereby, to reduce the expense of effluent disposal which is due to our "ignorance factor."

IV. Biological Considerations in Trickling Filters

by **LOUIS A. TUCCI**, *Sanitary Engr., Lederle Labs. Div., American Cyanamid Co., Pearl River, N.Y.*

THE first three articles in this series have presented fundamental considerations relating to experimental trickling filters, and have discussed how these units currently are designed and operated in the chemical industry. Part 4, the final article, will deal briefly with the biological relationships in experimental trickling filters.

By coincidence, the order of presentation of these articles parallels some present thinking in the approach taken to solve industrial waste treatment problems. Sanitary engineers unfortunately relegate the biology of waste treatment processes to last-place thinking. Evidence of this approach may be seen in many existing treatment plants. The steps taken in their creation were as follows:

First, various existing treatment methods were surveyed.

Second, experiments were undertaken on a laboratory or pilot plant scale. These usually were short-term experiments, which involved test runs ranging from several weeks to a few months, and rarely longer than one year in duration.

Third, selection of the chosen process was made, based primarily on the personal judgment and experience of a specialist.

Fourth, the plant was designed according to conventional standards.

Fifth, the plant, an imposing edifice of concrete, stone and steel, was constructed and readied for operation.

Sixth, the plant finally became an actual operational unit.

It was only when the plant was in operation that any concern was given to the biota (biological flora and fauna). Its existence and the part it would play were taken for granted.

Filter Biota and Chemical Waste

The reason for this attitude is a popular misconception that a good biological growth always occurs incidental to operating the trickling filter treatment process. The ultimate result of this misconception frequently is evidenced in the many industrial waste treatment plants that fail to meet the preconceived and desired treatment needs for which they were intended.

In a trickling filter, a good biological population just does not happen. There may be instances as in the case of sanitary sewage, in which the

waste to be treated already has undergone microbial attack and may contain as many as 400 million organisms per milliliter. This usually is not the case with organic chemical wastes. Accordingly, the author emphasizes the need for a sound, scientific approach to waste treatment problems *from the biologist's viewpoint.*

It has been established that the efficiency of a biological treatment process is primarily dependent on reactions initiated and maintained by the biota inhabiting the zoogleal matrix. In order to institute a biological process on a scientific basis, one must consider the media or waste to be acted upon, the organisms necessary to perform the action, and the proper environment or conditions to foster the action. The basic biological viewpoint is important if industrial wastes are to be successfully treated, because these wastes vary widely from plant to plant, differing greatly from sanitary sewage in this respect. The pollutants discharged from an organic chemical plant may be the process refuse from any one, or from a combination of a thousand different processes.

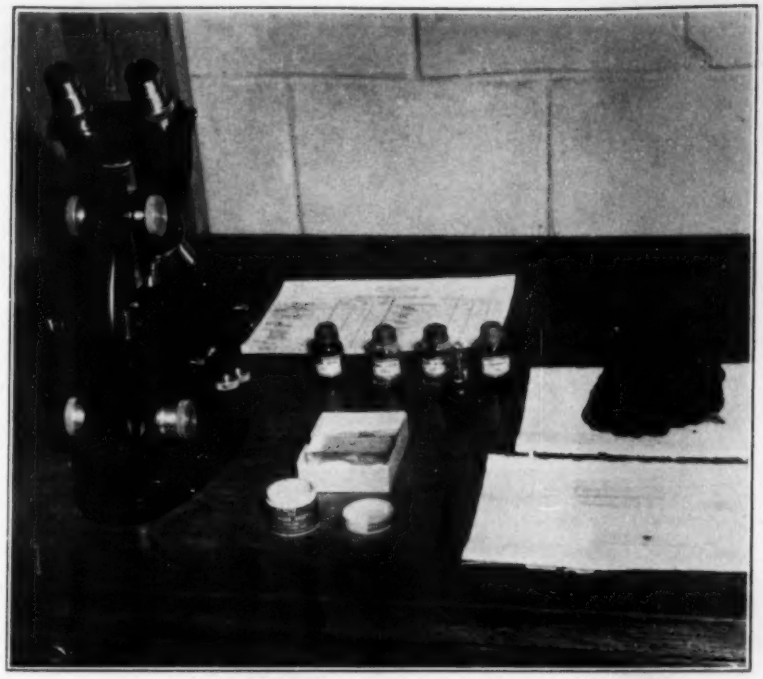


Fig. 3—LABORATORY equipment for examining filter slime
In background is tabulating sheet for recording microorganisms.

Sanitary Sewage Treatment

The methods of treating sanitary sewage are well established. Trickling filters, for example, have been in use for the past 60 years. The effectiveness of trickling filters in reducing the biochemical oxygen demand of sanitary sewage has been confirmed by many reports in technical literature.

Sanitary sewages are amenable to trickling filter treatment because they are easily stabilized, fairly constant in composition, and are readily oxidized. It has been established that sewage generally is composed of cellulose and other carbohydrates, proteins, fats, urea, and their decomposition products. These constituents occur so often in nature, that nature has provided a ready working force of many types of organisms able to use sewage as a culture medium.

Biological Treatment of Wastes

There are some industrial wastes that may be partially decomposed by biological fermentation processes, but there are many organic chemical wastes which are not readily attacked. The latter usually are high molecular weight cyclic, ring, or chain compounds, and may contain large amounts of dissolved metallic salts. The difficulty in treating these compounds lies not in their structure (for surely, the phenol structure is much simpler than that of skatol, commonly found in sewage), but rather in the fact that because they are so rare in nature, organisms able to utilize these materials as food are not numerous in the soil and natural waters. The needed organisms must be grown from a poor start.

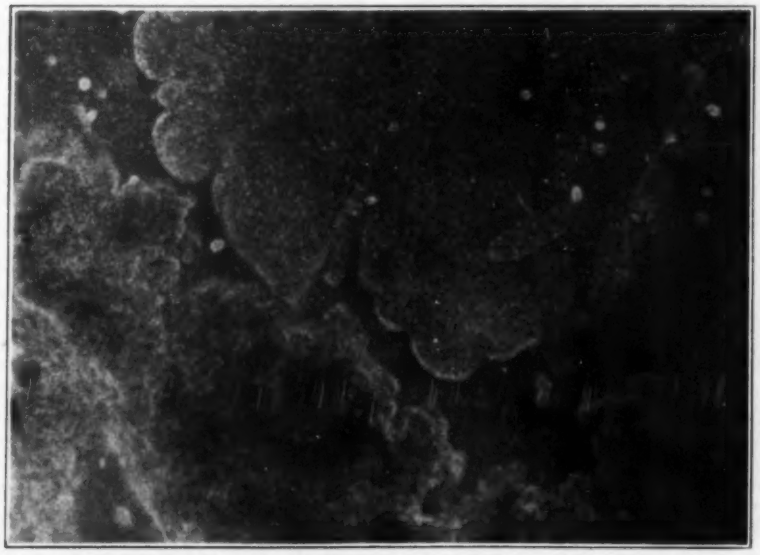
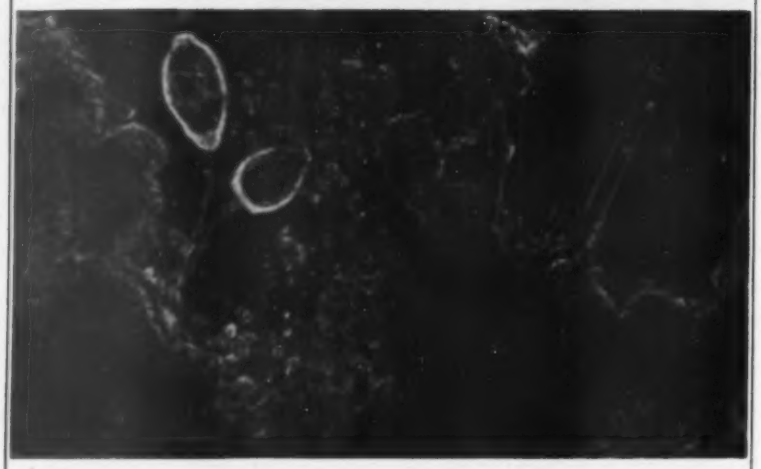


Fig. 4—FILTER slime is largely comprised of zoogleal mass illustrated above

It is for this reason that plant design based on laboratory B.O.D. values often proves inadequate. The true B.O.D. value of the wastes is determined only by seeding with a culture of organisms which readily attack the wastes, and this culture may require weeks to establish. To treat such wastes, therefore, is a problem either of acclimatizating and adapting organisms to do this work, or of determining which organisms in nature can decompose this material and then creating the necessary environment to promote their growth and activity. No matter from which view the treatment problem is approached, it is clear that the basic consideration is primarily biological.

It follows that, in order to design a biological waste treatment system, the



Figs. 5 (top), 6 (center) and 7 (bottom)—PHOTOMICROGRAPHS of microorganisms in filter slime (identified in text)

engineer must draw his basic information from the knowledge of associated fields of biology. When it is known how to treat the waste, there remains only the problem of using good engineering judgment and resourcefulness to provide the proper design. Lacking good data for designing a process, it will be difficult to operate the plant at desired efficiencies.

A biological waste system must provide a means for its biota to function; this is the purpose of the trickling filter, or of other biological units. The trickling filter biota only will be considered in this article.

Interrelated Functions of Biota

The organisms comprising the biota may be classified into six rather broad groups: bacteria, protozoa, algae, fungi, worms, and insect larvae. All these are described by species and genera. In the trickling filter slime, they organize into a rather closely knit and intricately balanced synergistic community. The stabilization of organic wastes is entirely dependent up the action, reaction and interaction of these organisms.

The biological system of these organisms is not constant, but is ever changing with environmental changes and with time. Some organisms, such as bacteria, depend upon the oxidation of organic materials for their source of energy. Aerobic bacteria utilize free oxygen in the substrate, while obligate anaerobes must get their oxygen from reducible products in the substrate or from the cleavage products of carbohydrates or proteins.

In the course of their metabolism, bacteria produce a great variety of substances. Some of these substances become food for other organisms. Substances such as enzymes play an important part in the nutrition of the organism and also in decomposition processes, through their capacity to split carbohydrates and to ferment various sugars and alcohols.

In the chain of metabolic activity, the byproduct of one organism becomes the nourishment for another until, under balanced biological conditions, the dead bodies and refuse of plant and animal origin are completely reduced to simple substances (carbon dioxide, nitrates and water). The simple substances can be used by algae or the chlorophyll-bearing plants, and thus resynthesized into materials which can serve as food for animals. The organisms in this way act as intermediates in maintaining the circulation of carbon and nitrogen in usable form between the animal and plant worlds.

One of the prime objectives in the operation of a biological waste disposal plant is to maintain a well-balanced biological flora and fauna. The balance depends on maintaining a highly competitive and diversified system. The danger of having particular species predominate is readily apparent. When this occurs, decomposition of the material would progress only to the limit of the capabilities of the specific organisms. It is of great value in the operation of a biological treatment process if the organisms in the system can be identified. By having knowledge of their physiological and ecological properties, it is possible to qualitatively evaluate the system with reference to the process of decomposition which will proceed.

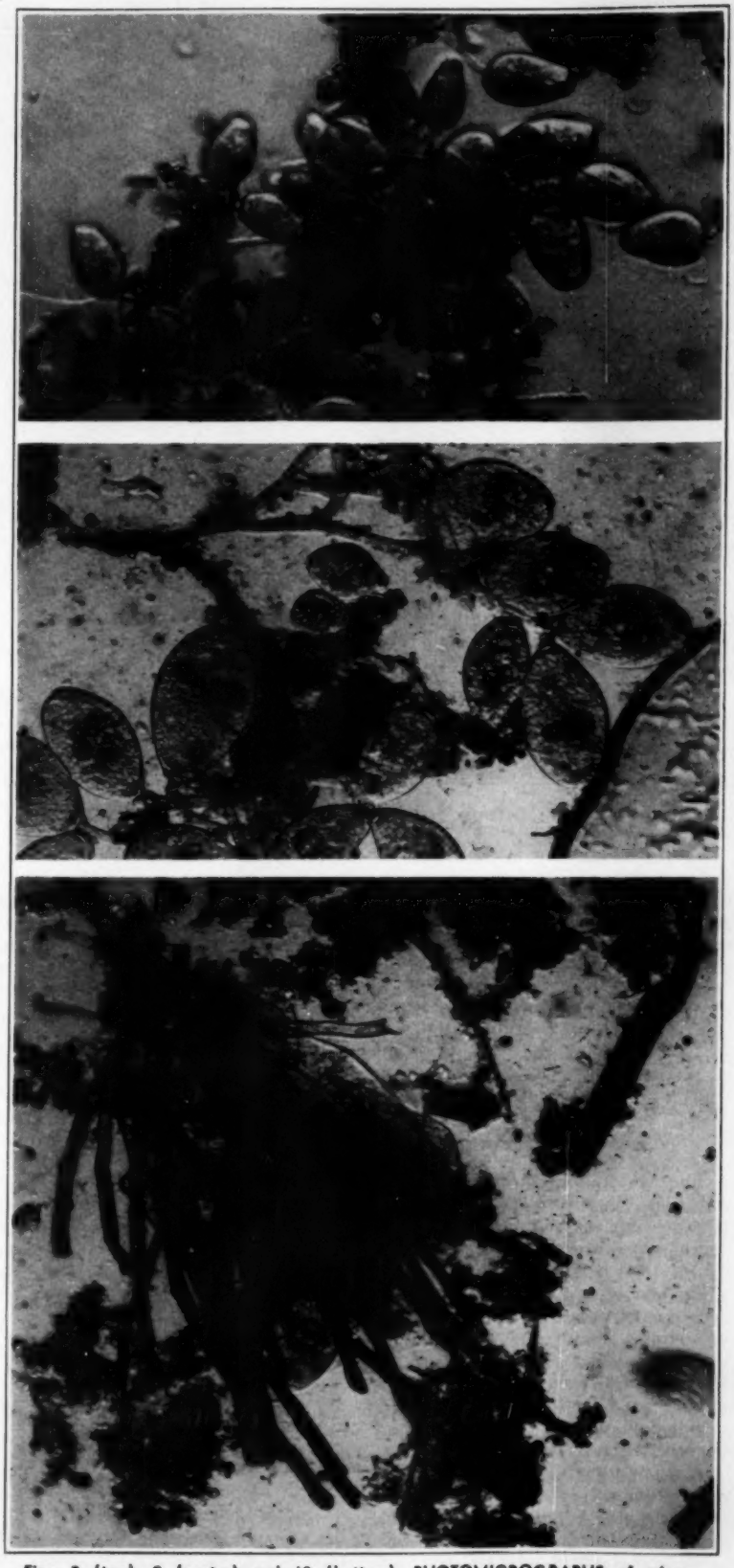
Bound Brook Laboratory Studies

At the Bound Brook plant of the American Cyanamid Company, microscopical and bacteriological investigations are conducted on the pilot plant effluent, in addition to various biochemical and chemical analytical tests. The results of the biological studies have been consistent with the quantitative laboratory tests. Further, experience derived from the biological studies is proving helpful in solving many operational problems that have been encountered.

Fig. 3 illustrates the setup of equipment used to identify the organisms in filter slime. In the background may be seen the tabulating sheet and the filter rock sample. Also in the picture are the various dyes and stains used and equipment necessary for the examination. The stains commonly used are Gram's and Ziehl-Neelsen stains. The microscope shown is a Bausch-Lomb Dynoptic microscope equipped with optics to give magnifications of 100, 430 and 970 diameters. The slime is examined in a wet mount preparation, using the technique similar to that employed in blood examinations.

Samples are taken from all four quadrants of the filter bed. In each quadrant the top and undersides of the surface stones are examined. An examination is also made of stones from within the filter at a depth of one foot. Fig. 4 is a photomicrograph of a typical zoogleal mass in the filter slime. Much of the purification process is generally accredited to growth of this nature.

Fig. 5 is a photomicrograph illustrating a cluster of colonial ciliates in the center. Throughout the entire picture may be seen "dots" of bacteria. Jutting from the masses may



Figs. 8 (top), 9 (center) and 10 (bottom)—PHOTOMICROGRAPHS of microorganisms in filter slime (identified in text)

be seen branched colonies of zooglea ramigera.

Fig. 6 is a photomicrograph showing two ciliated protozoa and "bamboo-like" shoots of a septiated fungi protruding from the mass.

Fig. 7 is a dark-field photomicrograph of a "whip-like" nematode or miscroscopic round worm, oval shaped flagellate protozoa, bacteria and hypha of fungi (at the right).

Fig. 8. is a photomicrograph of a "grape-like" cluster of colonial ciliates belonging to the family of protozoa called Peritrichae.

Fig. 9 is a photomicrograph depicting an interesting mass of Dematius fungi, Sphaerotilus and Geotrichum.

Fig. 10 is a photomicrograph showing various scattered bacteria and protozoa lurking within the shadowed fungi.

Summary

The problem of biological waste treatment is fundamentally an application of biological principles. A new biological technique is necessary to treat industrial wastes. An understanding of the biochemistry, chemistry, mycology, aquatic biology, and zoology is required in order that the biological treatment system can be efficiently designed.

Seven Rotovalves to Control Israel Water Supply

Valves to be used in the domestic water system of Tel Aviv, Israel, include seven 20-inch Smith Rotovalves en route from York, Penna., to an installation halfway around the world. Four other valves, also being manufactured by the S. Morgan Smith Company, will be shipped to Israel sometime next month. These additional units will be 24-inch size and will be constructed of cast steel.

The seven valves being exported at this time are cast iron, hydraulically operated Roto valves which will be complete with solenoid actuated controls when installed. All the valves, being made for the Meckoroth Water Company, Ltd., of Tel Aviv, will be used as pump discharge check valves. Production of the units was approximately a month and a half ahead of the promised shipping date.

V.P.I. Expands Summer Program in Sanitary Engineering

The Virginia Polytechnic Institute School of Engineering, in its Sanitary Engineering Division, is conducting a summer program of continuing education. The present program will include, in addition to the annual water and sewage plant operators school, two clinics featuring design and corrosion problems. A two-day Sanitary Engineering Design Clinic was held June 28 and 29 to cover current developments in the fields of sanitary engineering processes and design.

A second two-day clinic with corrosion control as the central theme will be held August 2 and 3. This clinic has been designed for engineers and chemists who are confronted with corrosion problems arising in both industrial and municipal water supply. The staff will be composed of leading engineers and chemists employed by various manufacturers producing equipment or materials for corrosion control.

The fifth annual operators training school will conclude the summer program. This five-day school, to be held August 16-20, will offer a program of study at three levels for both water and sewage plant operators. Sponsored and staffed by the Virginia Health Department and V.P.I., the operators school has in past years been very successful, drawing an attendance of 60 to 75 Virginians annually.

Cooperative Pollution Research Recommended for Industry

Roy F. Weston, Sanitary Engineer for the Atlantic Refining Co., reported in a paper presented at the annual meeting of the American Institute of Chemical Engineers, that more than $2,200,000 is spent annually in U.S.A. for research aimed to cut down industrial pollution.

"Industry's investment in waste treatment is of the order of magnitude of $1-billion," Mr. Weston said. The American people have spent several billion dollars to provide treatment facilities for reducing pollution by municipal sewage. The industrial pollution load is probably greater than the municipal load at present and will increase at a faster rate.

With this in mind, Mr. Weston urged the establishment of a research program conducted cooperatively by industry mainly because such work is "fundamentally the responsibility of industry."

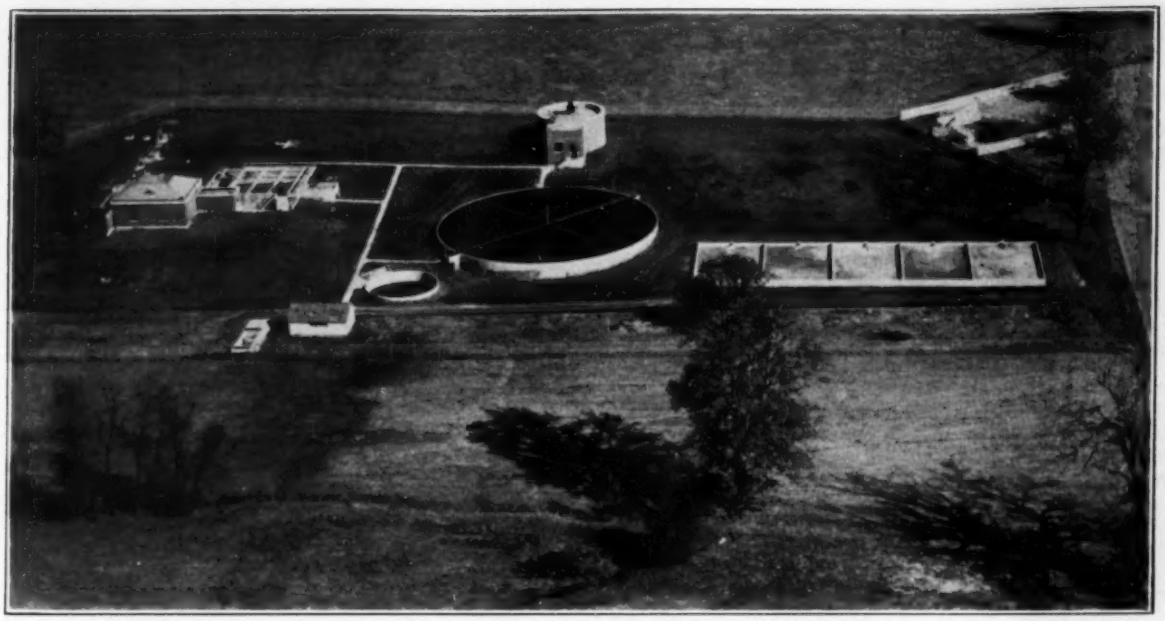
No Such Thing As a Standard Barrel*

How a Barrel of Oil Came to Be 42 Gals.

There is no "standard U.S. barrel." The writer has Hering's Tables before him in which Hering says, "One barrel has no legal or fixed value; it varies between 30 and 43 gallons—liquid; U.S."

But, there *is* a standard oil barrel of 42 gallons, first adopted by the Standard Oil Co., and here is the reason why it is 42 gallons: In the "old days" before tank cars or the building of pipelines, oil was transported over the rough Pennsylvania roads in 50-gallon barrels on flat-bed wagons. 50 gallons was then regarded as a barrel. But so much oil slopped out of the barrels that when the wagons reached the refineries or water shipping points it was found that the barrels contained an average of only 42 gallons. So the official petroleum barrel came to be 42 gallons, and remains such.

*Contributed by W. F. Schaphorst, M.E.



NEW U.S.P.H.S. hospital sewage treatment plant, Lexington, Ky.

New Plant for Hospital Sewage

Institutional conditions determined the equipment in this trickling filter treatment plant

by **ROBERT P. JOHNSON**, *Assoc., J. Stephen Watkins, Cons. Engrs., Lexington, Kentucky*

JUST outside of Lexington, Kentucky, in an area justly famed for its bluegrass, fine tobacco and beautiful horses, is located one of the U.S. Public Health Service Hospitals devoted to the treatment of narcotic addicts. An activated sludge plant of 300,000 gal. per day capacity, constructed in 1935, was originally provided to treat the sewage from this hospital. This plant consisted primarily of a bar screen, two Imhoff tanks, three aeration tanks, two secondary clarifier basins with sludge collection equipment, two glass-covered sludge beds, one re-aeration tank, pumps and appurtenant equipment. The outfall discharged treated sewage effluent into a small, dry weather stream.

At the time of construction of the original sewage treatment plant, the patient population averaged from 550 to 600 persons, employees averaged from 225 to 235 persons, and the average sewage flow was 172,000 gpd. In 1950 the patient population was 1102 and the employees numbered 525, with a corresponding increase in average sewage flow to 344,000 gpd. As a result of this growth, the original activated sludge plant was so overloaded that it had become unable to deliver a satisfactory effluent. In April 1950, the firm of J. Stephen Watkins, Consulting Engineers, was retained by U. S. Public Buildings Service, General Services Administration, to prepare an engineering report covering the requirements necessary to improve the plant and, upon acceptance of this report, to prepare working drawings and specifications.

Investigation and Report

The report indicated that, in general, the plant was considerably overloaded; that hospital, dairy, laundry, slaughterhouse and cannery wastes threw excessive shock loads on the plant; that proper air diffusion facilities were lacking; and that activated sludge return was not properly controlled. Because of the use of hospital patients as sewage plant laborers and the imposition of the above shock loads on the plant, it was the primary recommendation of the firm that the existing facilities be replaced by a standard rate trickling filter plant. It was recommended that, insofar as possible, utilization be made of certain sections of the existing plant. This included adapting the existing Imhoff tanks to a new primary settling tank and stand-by Imhoff tank, and using the foundations of the existing pump house and laboratory for the new head house.

Extensive investigations were made to determine special design values to use at this plant. The usual peculiarities of institutional sewage, extreme industrial waste loads, and the proposed installation of garbage grinders throughout the institution were taken into account. The results of these investigations indicated that the new plant should be designed for handling a flow of 600,000 gpd and for the recirculation of sufficient sewage to maintain this rate through the plant at all time. The population equivalent was calculated to be 4,000 persons,

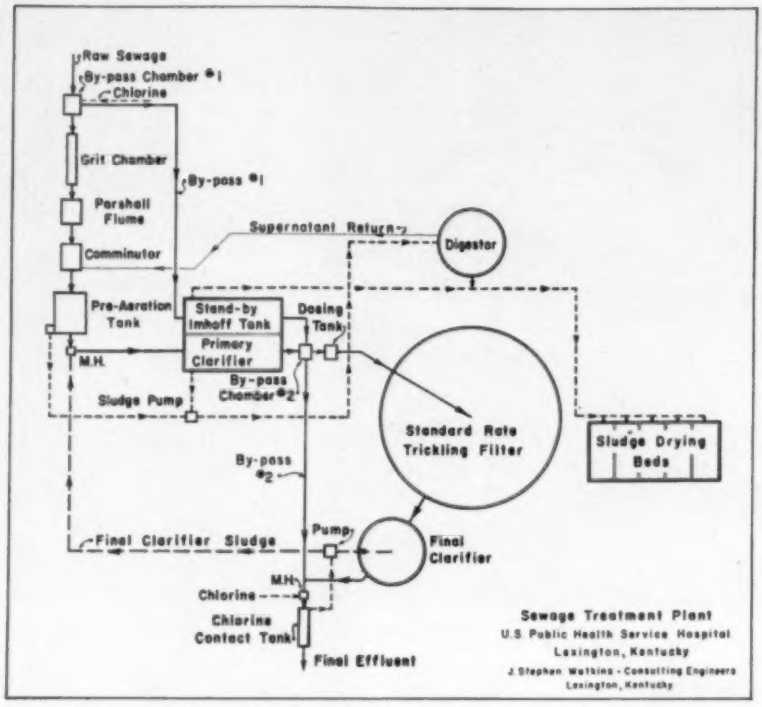
the average B.O.D. was calculated as 200 ppm, the suspended solids as 225 ppm, and the grease content as 150 ppm.

New Plant Built

In the new plant, the raw sewage from the hospital first enters a by-pass chamber where provision is made for pre-chlorination. From this point the sewage flows either to the grit chamber or to the stand-by Imhoff tank.

The flow normally is through a Jeffrey mechanically-cleaned grit chamber, where the grit is removed continuously by scrapers which discharge into a galvanized iron can. The chamber is 18 feet long and 18 inches wide. A 6-inch Parshall flume is located at the effluent end of this chamber, which is so designed that the maximum velocity of the sewage is one foot per second for all normal rates of flow. The Parshall flume is provided with a Builders-Providence Chronoflo transmitter, by means of which the sewage flow variations are transmitted to a Chronoflo receiver in the head house. The receiver is an indicating, totalizing and recording instrument capable of measuring sewage flows of zero to 1.50 mgd. Then, the sewage flows through a Chicago Pump Co. No. 10A Comminutor, where sewage solids, rags, and other materials are macerated.

From the Comminutor the sewage flows to the pre-aeration tank, which separates and removes grease. This is a 13-foot square tank with a side water depth of 8 feet, 9 inches, having a capacity equivalent to 25 minutes detention. The pre-aeration tank is equipped with an American Well Works Air Diffusion Unit and two Spiral Skimmers. The discharge from this tank passes through an intermediate manhole, at which point the recirculated sludge from the final clarifier is returned to the head of the plant. Then, the combined flow enters the primary clarifier. As mentioned above, this clarifier was constructed from one of the existing Imhoff tanks, from which the internal partitions were removed and the sloping bottom was filled and slabbed over. In this tank an American Well Works sludge collector, scum pipe and telescoping sludge control valve were installed. The concrete basin in 40 ft. by 18 ft. 6 in. by 9 ft. side water depth. This basin provides an equivalent detention period of 2 hours and a surface loading of 810 gallons per square foot per day. It has a weir overflow rate of 33,000 gal. per foot per day at the design rate of 600,000 gpd. Sludge is drawn off from the sludge hoppers



FLOW DIAGRAM showing integration of new and old units

in the tank through a Yeomans 4-inch Simplex sludge pump located in the head house, and is pumped to the sludge digester.

The effluent from the primary clarifier next flows into by-pass chamber No. 2. From this point the sewage normally flows to the dosing tank and thence to the trickling filter. If it is desired to by-pass secondary treatment, the sewage may be diverted through the plant by-pass line directly to the chlorine contact tank. It is possible to by-pass either the primary section or the secondary section of the plant, or both sections.

Recirculating Trickling Filter

Under normal operation, with recirculation of final clarifier sludge maintaining the flow at approximately 600,000 gpd, the sewage flows continuously through the dosing tank. The real function of the dosing tank is that of an emergency unit which goes into operation in case of a power failure or a pump failure which would stop the recirculation cycle.

The trickling filter unit is 100 ft. in diameter and includes a 10-ft. depth of stone placed over clay tile underdrains (Trickling Filter Floor Institute specification). A shear gate is provided at the filter discharge manhole so that the filter can be flooded if desired. The manhole is so designed as to flood only to the top of the stone layer and to permit flow through the filter to continue during flooding. At 600,000 gpd, the volume loading is equivalent to 330,000 gal. per acre foot; at 200 ppm average B.O.D., the organic loading is equivalent to 370 lbs. per acre foot. The dosing siphon and four-arm distributor were furnished by the Ralph B. Cater Co.

From the trickling filter the sewage passes to a circular final clarifier of a modified Dortmund tank type. This tank has a top diameter of 28 ft. with sides sloping to a bottom diameter of 8 ft., in the center of which there is a truncated cone decreasing in diameter from 6 ft. to 3 ft. The space between the outside tank wall and the inside truncated cone forms four hoppers, from which the suction is taken for the recirculation sludge pumps. The tank has a side water depth of 15 ft. The clarifier has a detention period of 1.5 hours and a surface loading of 970 gallons per sq. ft. per day.

Adjacent to the clarifier is the underground pumping station, in which are located two 150 gpm American Well Works pedestal-mounted sewage pumps. These normally draw from the final clarifier, but may draw from the chlorine contact tank. The controls of the pumps are interconnected with the main sewage meter in the head house so that when flows of less than 400,000 gpd enter the plant, one pump will operate; and when flows of less than 200,000 gpd enter the plant, two pumps will operate.

From the final clarifier the sewage flows through an intermediate manhole, at which point chlorine is applied for post-chlorine treatment. The plant is equipped with a Wallace & Tiernan Type MMSV vacuum chlorinator located in the head house. Thus, the chlorine solution may be applied at the by-pass chamber for pre-chlorination, or at the manhole for post-chlorination.

The sewage next enters the final unit of the plant, the chlorine contact tank. This is a baffled tank, rectangular in shape, 16 ft. long by 6 ft. wide by 8 ft. side water depth, equivalent to a detention period of 15 minutes. A 10-inch vitrified clay pipe carries the effluent to the creek, approximately 200 feet distant.

Plant Flexibility

As recommended in the report, the second of the two original Imhoff tanks was modernized and now is used as a stand-by unit. If primary units of the plant are out of service, the sewage can be diverted at by-pass chamber No. 1 to flow through the stand-by unit. Thus, under the most difficult conditions, the sewage will receive some degree of primary treatment. The effluent from this unit flows to by-pass chamber No. 2.

Sludge from the primary clarifier is pumped to the digestion tank which is 30 ft. in diameter and has a side water depth of 22 ft. The total sludge storage capacity is 14,000 cu. ft., which is equivalent to 3.5 cu. ft. per capita. The digestion tank is provided with a Pacific Flush Tank Co. floating cover. Sludge in the digester is recirculated through a 100,000 Btu PFT heat exchanger by means of a 75 gpm Fairbanks-Morse close-coupled vertical sewage pump. The raw sewage is pumped into this recirculation line just beyond the recirculating pump discharge and before the influent to the heat exchanger. The sludge can be drawn from the digester and discharged to any of five sludge beds of conventional design. The total area of the beds is 6750 sq. ft., equivalent to a loading of 1.70 sq. ft. per capita.

The raw sludge pump, the chlorinator, the raw sewage flow meter, and a fully-equipped laboratory are located in the head house. This structure, constructed on the foundations of the original pump house and laboratory, has a superstructure built of brick with tile backing. The exterior design was made to conform to the general architecture of the hospital buildings.

Acknowledgment

The contract plans and specifications were developed by the firm of J. Stephen Watkins, Consulting Engineers, Lexington, Kentucky, and were approved by the Supervising Architect, U. S. Public Buildings Service, General Services Administration. Acknowledgment is given to Mr. W. W. Towne, Officer in Charge, Ohio and Tennessee Drainage Basin, USPHS, Cincinnati, Ohio, for his valuable aid in working out many of the technical features of the plant.

The general contract was awarded to Goodwin Construction Co. of Jeffersonville, Indiana, on the basis of its low bid of $229,760 and the plant was constructed under the field supervision of Mr. Charles R. Mather. Construction was supervised by the U. S. Public Buildings Service of the General Services Administration under the direction of Mr. L. H. Treece, Deputy Regional Director. The operation of the plant is supervised by Mr. D. T. Miller, Chief Operator.

Chemical Characteristics of Pennsylvania's Surface Waters

Recently issued is Publication No. 26 of the Pennsylvania Dept. of Commerce entitled "Chemical Character of Surface Water in Pennsylvania 1949-1951." This is the third in a series of publications reporting on the results of the investigation conducted by the U. S. Geological Survey in cooperation with the Pennsylvania State Planning Board. Publications No. 17 and No. 23 contain the data for the periods 1944-1946 and 1946-1949 respectively.

Publication No. 26 contains chemical analyses of composites of daily samples collected from 29 places in Pennsylvania for periods of one or two years, and one or more chemical analyses from about 144 other places in the commonwealth. The analyses are useful for evaluation of the suitability of the water for a wide variety of industrial and other uses.

Copies of this publication may be obtained free on application to either of the following:

U. S. Geological Survey
Room 1302, U. S. Custom House
Philadelphia 6, Pa.

or

Pennsylvania Dept. of Commerce
State Planning Board
State Capitol Building
Harrisburg, Pa.

Karl M. Mason to Head Sanitary Engineering in Penna. Health Dept.

Mr. Karl M. Mason has been appointed Director of Environmental Health Services in the Pennsylvania State Department of Health, it was announced recently by State Secretary of Health, Dr. Russell E. Teague.

Under a new organizational plan, the Department of Health has combined its operating units into three groups—Preventive Services, Local Health Services, and Environmental Health Services. As Director of this latter group of units, Mr. Mason will direct the functions of the Bureaus of Sanitary Engineering, Sanitation, and Industrial Hygiene which include the supervision of public water supplies and sewage disposal, industrial waste treatment and mine drainage, public bathing places, the sanitation of restaurants, camps and schools.

LITTLE DOES SHE KNOW . . . what she is doing to the local sewage treatment plant.

Water Woes and Willing Wives

During the recent AWWA Convention in Seattle the following, which appeared in one of the local papers, was credited to the New York Times News Service. As a suggested remedy for water shortages it has possibilities.

The World Health Organization claims no responsibility for the idea which it records in an official publication as having originated with an Asiatic as one available method of solving a water shortage problem.

"We have in one area here some wells which furnish water indispensable to life but which are 13 to 14 kilometers distant from the community. A wife can make only one trip a day to fetch the necessary water, which she carries in a bucket. This quantity of water is quite insufficient for the needs of a husband. The only solution, therefore, is to have more than one wife."

SEWAGE WORKS PRACTICES

Sludge Digestion

Tenth in a Series

by DON E. BLOODGOOD, *Professor of Sanitary Engineering, Purdue University, Lafayette, Ind.*

IT HAS previously been pointed out that the basic principle in sewage treatment is the separation of the solids from the water. Suspended solids are removed by primary sedimentation or by secondary treatment using activated sludge or trickling filters. Dissolved solids removal is accomplished by the biologic processes of secondary treatment.

The solids that are removed must be disposed of in a satisfactory manner. The raw solids of primary sludge will decompose readily; but even in the original state, as fresh primary sludge, the solids are objectionable from the odor standpoint. It is, therefore, necessary to resort to some method of disposal of solids removed from sewage so that no great quantity accumulates, or that there is no nuisance caused by the removed solids.

Anaerobic Digestion

It has been common knowledge for centuries that buried organic matter decomposed and without objectionable results. It is quite apparent that such decomposition must take place in the absence of air. Decomposition taking place in the absence of air is called anaerobic digestion, and is carried on by microorganisms that obtain their needed oxygen from their food.

The microorganisms convert the carbon, hydrogen, and oxygen of the organic compounds into gases that contain combinations of the three elements mentioned. It is easily understood then that the conversion of solids to gases results in a material reduction in the pounds of solids that remain. This reduction in solids makes it possible to use a septic tank for a long period of time without removing any solids. The same type of anaerobic decomposition takes place in the sludge digestion compartment of an Imhoff tank. The decomposition of sludge solids can be expected to reduce the quantity of organic matter by about fifty per cent, and in this manner digestion results in a very much reduced quantity of material that must be disposed of. There is the added advantage that the digested sludge is not particularly objectionable from the standpoint of odor.

The Digestion Process

The bacteria that cause anaerobic decomposition apparently are present practically everywhere on the face of the earth. Decomposition of the solids appears to proceed in two steps, and it is commonly assumed that there are two classes of bacteria that do the decomposing. Sometimes these groups have been called the "first" and "second" teams.

The first group of bacteria takes the organic solids and converts them to organic acids and then the organic acids are converted to the two common gases of digestion, carbon dioxide and methane. The reasoning supporting the two-stage theory is that in some instances the quantity of volatile acids present is greater than in other instances. This indicates that there is not a fixed relation between volatile acids present and the quantity of gas produced.

Bacteriologists have not been very successful in observing or counting the bacteria of anaerobic digestion and this, therefore, explains why suppositions have to be made regarding what happens in the process of digestion.

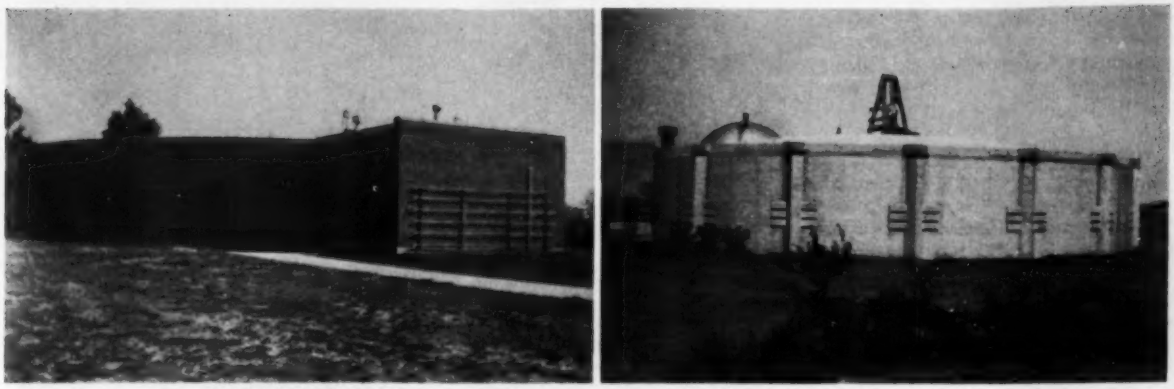
It is possible to determine the organic matter present in sludge solids, the volatile acids in the digesting sludge, and the quantity of gas produced. It is with this information that the steps in digestion are studied and it will be necessary to rely upon such information as a guide in operation until new techniques are devised and proven.

Temperature and Digestion

Bacteria are very sensitive to temperature and their activity depends to a great extent upon the temperature at which they are working. The lower the temperature the less active are the organisms. The decomposition of sludge practically stops at temperatures below 50°F, and the most rapid decomposition takes place at between 85 and 95° F. There is a great difference in the rate of decomposition between 70 and 80° F, and not much of a change in rate between 80 and 95° F. These statements explain why it is so desirable to maintain temperatures above 80° F in digestion tanks.

Separate Digestion Tanks

It has just been pointed out that increased temperatures speed up digestion and it was this information that prompted the construction of separate tanks where elevated temperatures could be maintained. In the Imhoff tank and septic tank, sewage flowing through would carry away more heat than could be reasonably applied to maintain warmer temperatures. This same carrying away of heat occurs in a separate sludge digestion tank when a large volume of sludge is added to a tank each day, since a like volume of supernatant or digested sludge is removed and carries out heat. It is desirable, there-



SLUDGE DIGESTERS at the Evansville, Ind., and Hammond, Ind., sewage treatment plants

fore, to add sludge to a separate sludge digestion tank in as concentrated a form as possible.

Starting a Digestion Tank

There have been many difficulties experienced in starting operation of separate sludge digestion tanks, but once a tank has been in operation for a year or so there are not apt to be any routine difficulties providing excessive amounts of solids are not added.

An accumulation of well-digested sludge in a digester seems to have a very beneficial effect upon operation. It is likely that there are two factors that make the presence of digested sludge desirable. Well-digested sludge no doubt contains considerable numbers of the bacteria that feed on the raw sludge. Therefore, having a large number of organisms present speeds up the decomposition rate. The digested sludge also seems to have a stabilizing effect and does not permit the formation of conditions that are unfavorable for the growth of organisms or for the decomposition of organic matter.

The desirability of having digested sludge present in a tank indicates the value of using some digested sludge to start an operation of tank. To get digested sludge is not always an easy matter, because transporting and pumping sludge to a new digester are not easily accomplished. Some attempts have been made in the past to ship tank car or tank truckloads of digested sludge to a new plant when starting a new digestion tank. As this requires considerable effort, and as the cost in time and money usually is excessive, the operator becomes discouraged before enough sludge has been transferred. If starting a new tank permits the use of digested sludge from older units, it is advantageous to use the well-digested sludge.

Many times when an entirely new sewage plant is put into operation, all available sewage is taken into the plant on the first day. This is a mistake, because there is a great quantity of sludge that must be disposed of on the first day and there is no digested sludge to seed and buffer the raw sludge solids.

It seems sensible, therefore, to start operation of the digestion tank by filling it with sewage, heating the sewage to 80-90° F, and then adding sludge at about 10 per cent of the rate that is ultimately anticipated. In order to take such a small proportion of the available sludge it is necessary either to cut the sewage flow, and thus to accumulate only a small quantity of sludge, or to waste the sludge to some other place. The former is the most desirable.

As soon as digestion starts, gas will be produced. Measurement of the gas volume each day will provide an excellent way of determining how the digestion is progressing. If there is a steady increase in gas volume from day to day, it may be assumed that the quantity of sludge added can be increased. A digestion tank so started can be expected to take a full load of solids each day after about sixty days of building up at the reduced loading rate.

Sludge Digestion Tank Operation

This decreased loading may seem questionable to some, but those who have had difficulties in starting digestion tanks will be willing to subscribe to a procedure that will decrease the problems always accompanying the operation of a tank that is overloaded at the start.

It has been pointed out that the purpose of a digestion tank is twofold: (1) to convert the organic solids into gases and thereby reduce the quantity of organic solids, and (2) to concentrate the remaining solids into a denser sludge, thereby further decreasing the amount of sludge that must be disposed of.

To carry out these two steps effectively in one tank is not an easy matter, because there are two processes going on that are not exactly compatible. If it is desired to convert a maximum of organic solids to gas, then there will be such an evolution of gas that the tank contents will continuously be stirred up. In this instance, there will not be suitable conditions for settling and concentration of the solids, and there will be no comparatively clear liquid to draw off as supernatant.

It is these two different end results that have prompted recommendations for the use of primary and secondary digestion tanks. The primary digestion tank is the one where most of the gas is removed, and the secondary digestion tank is the one where the concentration of solids and the removal of supernatant is accomplished.

Scum Formation

In some instances the gas carries a portion of the solids to the top of the tank where they form a scum. There have been numerous devices designed for breaking up scum. Some of these devices have been more successful than others, but no one has expressed the belief that it is detrimental to break up the scum.

Scum is buoyant and full of gas, and as it accumulates it actually lifts the solids out of the liquid. Very little decomposition takes place in the scum and there is little or no breakdown of the scum layer.

The most recently described units for scum-breaking have been designed to recirculate gas through the liquid at a rate that will break up the scum. There are claims made that agitation with the gas mixes the seed sludge thoroughly with the incoming raw sludge and thereby brings about more rapid digestion.

Sometimes digestion tanks have to be taken out of service and the scum removed. This is a difficult task and can be very dangerous, because it is not safe to get into a tank where there are solids undergoing decomposition. The methane is explosive and the carbon dioxide is a smothering gas.

Heating Digestion Tanks

The optimum temperatures for digestion have been discussed. The elevation of temperature is accomplished in several ways, the two most common being: (1) hot water coils inside of the digestion tank and (2) a heat exchanger on the outside of the digestion tank through which is pumped sludge from the digestion tank. Both types are satisfactory; however, some claim the heat exchanger eliminates the need for taking the tank out of service to clean the coils while others say that the heat exchanger requires extra pumping of sludge.

With a hot water coil installation it is important to keep the entering water temperature at about 130° F. If the water is hotter than this there is apt to be caking of sludge on the coils and coils so coated are as well insulated as if they were covered with an insulating material.

Sometimes heating is accomplished by the burning of the gas produced in the digestion tank, sometimes the exhaust gases from gas engines are used as sources of heat, and then, too, the cooling water of gas engines is sometimes circulated through the heating coils in the digestion tank. Usually the external heat exchangers are operated on heat from the gas burned in a furnace.

Grease Disposal

Some sewage plants are so designed that the skimmings are disposed of by pumping them to the digestion tanks. The animal and vegetable fats and oils are readily acted upon by the bacteria in the digestion tanks providing the oil or fat is kept submerged. Sometimes the mineral oils that are not readily decomposed by bacteria are mixed with the organic fats and oils and the whole mass forms a scum that is not easily handled. Mineral oils and greases have no place in a digestion tank and should be excluded from solids pumped to the tanks.

HEATERS operated on sludge gas, Shades Valley Plant, Birmingham, Ala.

Toxic Substances

Many times when digestion tanks are not producing gas the claim is made that there must be some toxic substance that is inhibiting bacterial growth. This is not an impossible happening, but before making a declaration that toxic substances are present, every effort should be made to make sure that there are no leaks that permit the gas produced to be wasted.

Copper is a common toxic substance that has been known to give trouble in digestion tanks. The tolerance of the bacteria to copper is not exactly known because the chemical form of the copper seems to be of importance.

Sludge Withdrawal

Digestion tanks usually are designed to retain the digested sludge for a rather long period of time. In some instances operators do not draw any sludge during the winter months, because of poor drying conditions on uncovered beds during the colder season.

A digestion tank usually has the sludge draw-off point located at the bottom, with three other points of liquid draw-off at different depths of the tank. Sludge should be drawn from the digester when thick liquid can be observed at any of the upper levels.

When drawing sludge to the drying beds, not all of the thick sludge should be drawn off at one time because there would not be a sufficient amount of seed sludge left in the tank in such a case. There can be more harm done in drawing out too much sludge than there can in not drawing out enough.

The sludge can be expected to dry well on a drying bed if the sludge being drawn is black in color, has a tarry odor and, when placed in a bottle, shows drainage streaks like those observed in a buttermilk bottle.

Summary

1. Sludge digestion is believed to proceed by two steps.

2. A separate sludge digestion tank should be started by the addition of small amounts of sludge to a heated tank.

3. Digestion proceeds best at temperatures between 80-90° F.

4. Fats and oils from plants and animals will decompose in digestion tanks if they are not present in quantities that form objectionable mats.

5. Care must be exercised to avoid drawing too much digested sludge from a tank.

W&SW

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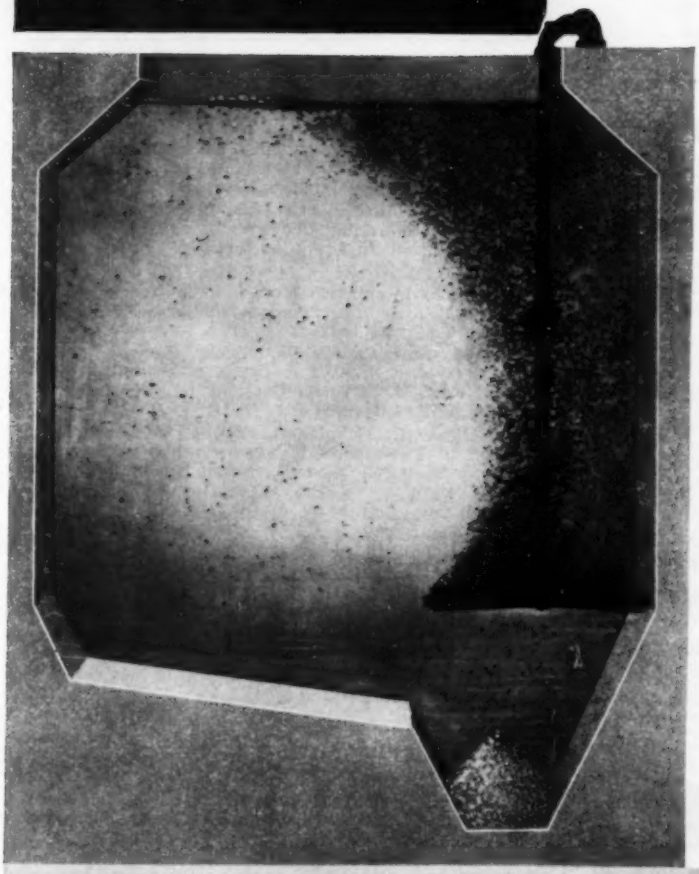
Extremely flexible in operation, the Aer-Degritter* can maintain proper settling velocities regardless of the rate of sewage flow.



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Aer-Degritter* Systems may be installed in existing structures at the head end of pre-aeration and grease removal tanks. Other applications include use in wet wells of lift stations for grit and odor removal and in power plant and waterworks intakes.

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,144,385, No. 2,328,655 and No. 2,555,201.

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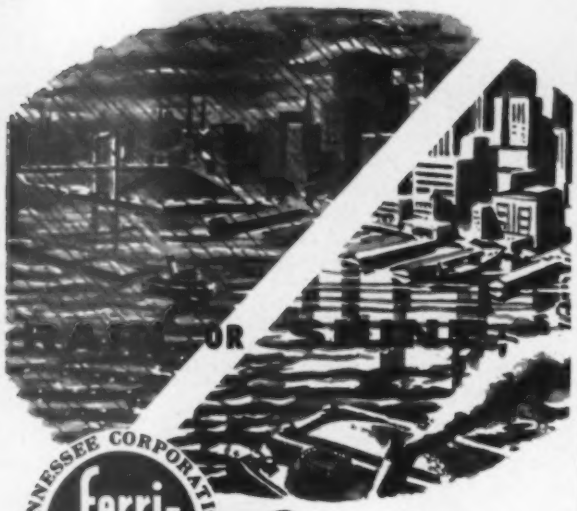

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Aug. 11—Bingham, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 23-27—Durham, N. C. *(Duke Univ.)*
NORTH CAROLINA WATER WORKS OPERATORS' SHORT COURSE. (15th Annual Course). Chairman, J. H. Henderlite, 1515 Elizabeth Ave., Charlotte, N. C.

Aug. 23-25—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y R. R. Kountz, Pennsylvania State College, State College, Pa.

Aug. 25-27—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. S. Bush, Dept. of Health, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 8-11—Digby, Nova Scotia *(Digby Pines Hotel)*
MARITIME PROFESSIONAL MEETING, ENGINEERING INSTITUTE OF CANADA, ASSOCIATION OF PROFESSIONAL ENGINEERS. Write, G. W. Frey, P.O. Box 1507, Halifax, N.S.

Sept. 9-10—Montauk, N.Y. *(Montauk Manor)*
NEW YORK SECTION A.W.W.A. (Annual Fall Meeting). Sec'y, Kimball Blanchard, 50 West 50th Street, New York, N.Y.

Sept. 14-16—Waterloo, Iowa *(Hotel Russell-Lampson)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 15-17—Muskegon, Mich. *(Occidental Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, Dept. of Health, Lansing 4, Mich.

Sept. 19-22—Atlantic City, N. J. *(Hotel Claridge—Exhibits, Convention Hall)*
AMERICAN PUBLIC WORKS ASSOCIATION. Exec. Dir., Donald Herrick, 1313 E. 60th St., Chicago 37, Ill.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 420 6th Ave., N., Nashville, Tenn.

Sept. 20-22—Nashville, Tenn. *(Andrew Jackson Hotel)*
KENTUCKY-TENNESSEE INDUSTR'AL WASTES & SEWAGE WORKS ASSOCIATION, Sec'y, R. Paul Farrell, 420 6th Ave. N., Nashville 3, Tenn.

Sept. 22-24—Dayton, Ohio *(Biltmore Hotel)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, Ohio.

(Continued on page 96A)

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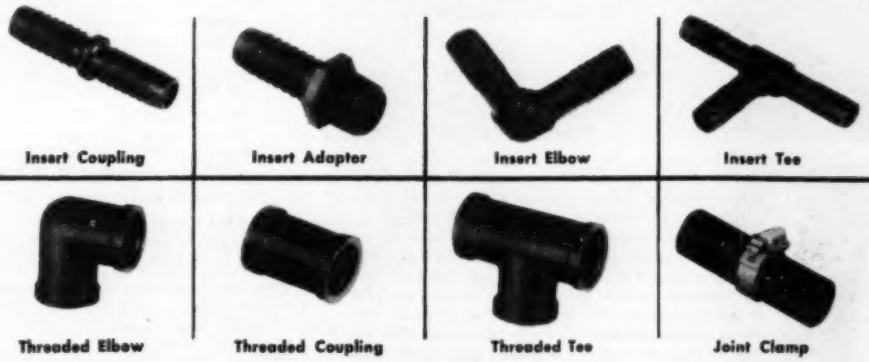

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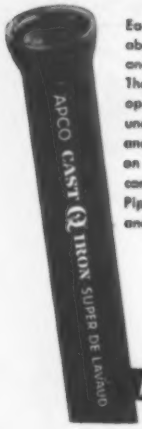

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(Continued from page 94A)

Sept. 22-24—Regina, Sask. *(Saskatchewan Hotel)*
WESTERN CANADA WATER & SEWAGE CONFERENCE. Sec'y, W. J. Waddell, 3610 Manchester Road, Calgary, Alberta.

Sept. 22-24—Grand Forks, N. D. *(Dakota Hotel)*
NORTH DAKOTA WATER & SEWAGE WORKS CONFERENCE. Sec'y Jerome H. Svore, State Dept. of Health, Bismarck, N.D.

Sept. 22-24—Atlanta, Ga. *(Ga. Institute of Technology)*
GEORGIA WATER & SEWAGE SHORT SCHOOL. Write, A. T. Storey, 1210 Hemphill Ave., N.W., Atlanta, Ga.

Sept. 26-28—Jefferson City, Mo. *(Governor Hotel)*
MISSOURI SECTION A.W.W.A. Secy, Warren A. Kramer, State Office Bldg., Jefferson City, Mo.

Sept. 26-28—Jefferson City, Mo. *(Hotel Governor)*
MISSOURI WATER & SEWAGE CONFERENCE. Sec'y, Warren Kramer, State Office Building, Jefferson City, Mo.

Sept. 28-30—Green Bay, Wis. *(Northland Hotel)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison 3, Wis.

Sept. 28-30—Mitchell, S. D. *(Lawler Hotel)*
SOUTH DAKOTA WATER & SEWAGE WORKS. Sec'y, Charles E. Carl, State Dept. of Health, Pierre, S. D.

Oct. 4-5—Moncton, New Brunswick, Can. *(Hotel Brunswick)*
MARITIME BRANCH, AMERICAN WATER WORKS ASSOCIATION. Sec'y, J. D. Kline, P.O. Box 574, Halifax, N. S.

Oct. 4-6—Poland Spring, Me. *(Poland Spring House)*
NEW ENGLAND WATER WORKS ASSOCIATION. (73rd Annual Convention). Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Oct. 4-6—Atlantic City, N. J. *(Chalfonte-Haddon Hall)*
PENNSYLVANIA MUNICIPAL AUTHORITIES ASSOCIATION. Sec'y, Claude C. Fogelman, 1717 Main St., Northampton, Pa.

Oct. 6-8—St. Paul, Minn. *(Lowry Hotel)*
MINNESOTA SECTION A.W.W.A. Sec'y, Leonard N. Thompson, Gen. Mgr., Water Department, St. Paul, Minn.

Oct. 11-14—Cincinnati, O. *(Netherland Plaza Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATIONS. (27th Annual Convention). Exec. Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.
(In conjunction with)
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT ASSOCIATION. Sec'y, Ward E. Conrad, 301 Ohio Departments Bldg., Columbus 15, Ohio.

Oct. 11-15—Buffalo, N. Y. *(Statler Hotel*—Tech. Sessions, *Memorial Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION. (Annual Meeting). Sec'y, Mrs. W. R. Walsh, A.P.H.A., 1790 Broadway, New York, N.Y.

Oct. 13—Brunswick, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 13-15—Cedar Rapids, Iowa *(Roosevelt Hotel)*
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Iowa.

Oct. 17-20—El Paso, Texas *(Cortez Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 18-20—*Pittsburgh, Pa. (Hotel William Penn)*
ENGINEERS SOCIETY OF WESTERN PENNSYLVANIA. (15th Annual Water Conference). Sec'y, W. M. Porter, Hotel Wm. Penn, Pittsburgh, Pa.

Oct. 18-22—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY CIVIL ENGINEERS. (Annual Meeting). Exec. Sec'y, Wm. N. Carey, 33 West 39th St., New York, N.Y.

Oct. 19-22—Atlantic City, N.J. *(Chalfonte Hotel)*
PENNSYLVANIA WATER WORKS ASSOCIATION. Sec'y, David Dunlap, 504 N. Second St., Harrisburg, Pa.

Oct. 24-27—Birmingham, Ala. *(Tutwiler Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, State Department of Health, Montgomery, Ala.

Oct. 26-29—Long Beach, Calif. *(Wilton Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 27-28—Springfield, Ill.
ILLINOIS WATER WORKS OPERATORS CONFERENCE. Sec'y, Clarence W. Klassen, State Dept. of Health, Springfield, Ill.

Oct. 27-29—Baltimore, Md. *(Belvedere Sheraton Hotel)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl Lauter, 6955 33rd St., Washington 5, D.C.

Oct. 28—Bridgeport, Conn. *(Hotel Stratfield)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R.I.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanaugh, 915 Colonial-American Bank Bldg., Roanoke 11, Va.

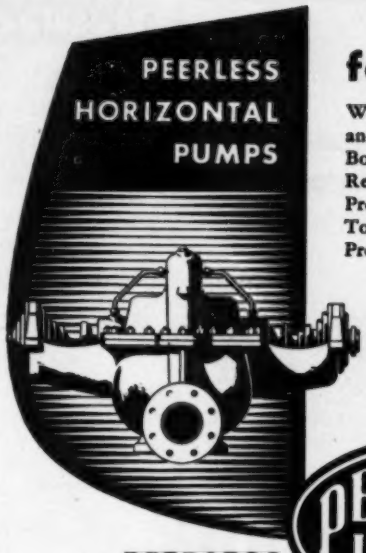
Nov. 4-6—Atlantic City, N.J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. Sec'y, C. B. Tygert, Box 178, Newark 1, N.J.

Nov. 8-9—Huntington, W.Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W.Va.

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-10—Asheville, N.C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N.C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.



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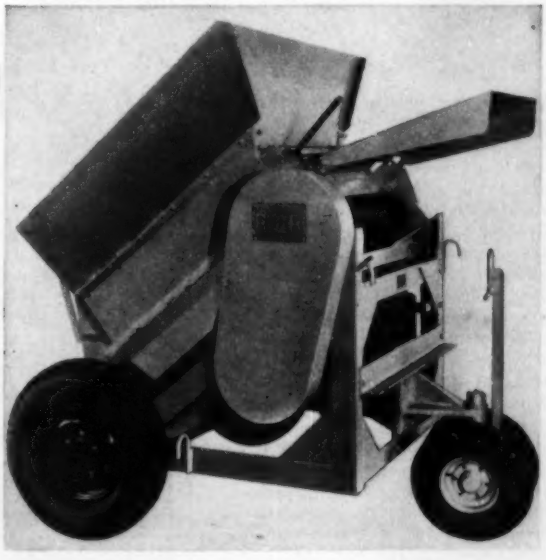

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FILTER BOTTOMS

Successfully serving over 200 PLANTS with a daily capacity of over THREE-QUARTER BILLION GALLONS!

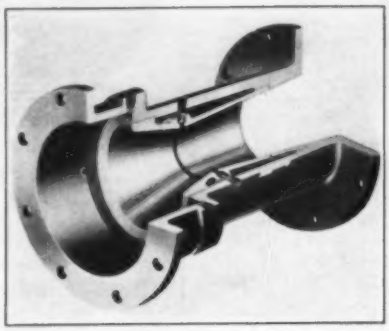
The Leopold Duplex Filter Bottom is made up of individual blocks, each weighing about 100 pounds, which are firmly joined together to provide a strong bed that is not disturbed by wash water. With this efficient, enduring system, you're assured an equal collection of filtered water with extremely low loss of head. There is no possible corrosion or tuberculation anywhere in the filter bottom.

Made of deaired fire clay—vitrified and salt glazed, the highly efficient Leopold Filter Bottom requires only shallow depth of small sized filter gravel and is acid and alkali resistant. Adaptable to any rectangular filter unit, it won't absorb any detrimental amount of water—and it's permanent.

Write today for details

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

Manufacturers & Equipment News



New Device For Fluid Measurement

801

Builders-Providence, Inc., Providence, R.I., has announced a new device known as the Dall Flow Tube for metering liquids and gases.

The Dall Flow Tube is designed for use with gases and liquids carrying no settleable solids. It consists of a short, flanged, cylindrical body designed with an abrupt decrease in diameter, followed by a conical restriction and diverging outlet.

The reduced area at the cone entrance together with the design of the annular throat induces the high differential pressure obtained; the diverging outlet cone provides the high recovery of differential pressure. Performance has been proved by years of experience and extensive hydraulic laboratory tests.

Features of the Dall Flow Tube include: Lowest permanent head loss of any known differential producer of the velocity increaser type, short length and low weight to provide for easy installation, MEEHANITE Iron body, corrosion resistant bronze liner, minimum maintenance provided by unobstructed flow path, accuracy assured by precision machined bronze throat liner and low cost resulting from compact design.

EDDY valves

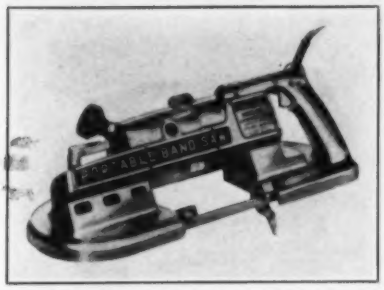
for

- Extensions and New Installations
- Installation of New Valves in existing lines
- Replacement of worn-out valves
- Shut-off Valves for hydrants

because

- Taper seats provide positive, self-wedging action assuring no-leak closing.
- Only 3 moving parts.
- Even new employees without special training can service and maintain an Eddy Valve.
- Available with standard or "O"-Ring packing.
- Furnished with bell, flange or mechanical joint connections to fit any existing or planned installation.
- 104 years of successful operations assure availability of repair parts.
- Conform to all A.W.W.A. specifications.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons
WATERFORD, NEW YORK



Portable Metal Band Saw

802

The Porter-Cable Machine Company, Syracuse, N.Y., has introduced an electric metal-cutting band saw that is not just movable but completely portable.

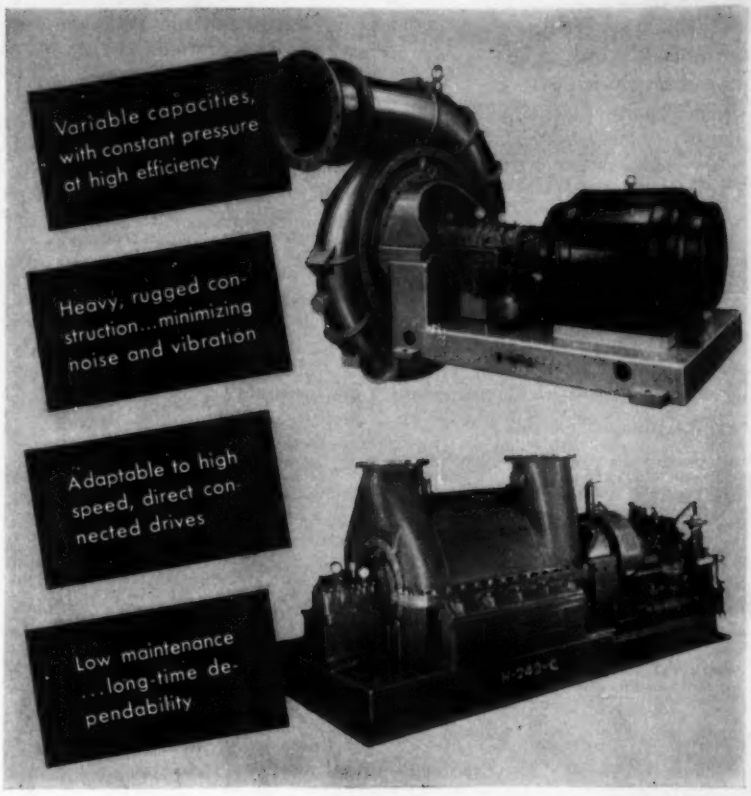
The new Model 524 Porta-Band Saw weighs only 16 lbs., is scarcely larger than a hand hack saw, and is 15 times faster by actual test. It is said to be the only metal-cutting saw ever made that is fast and light enough to be used free-hand in any position. The 524 with a stock-cutting capacity up to 3¼" by 4¼" is equal to a large hack saw. Equipped with a powerful motor, this compact machine eliminates fatigue, makes a cleaner, more accurate cut, and saves hours of time on jobs that formerly had to be done by hand. Even inexperienced workers can cut ferrous and non-ferrous metals, plastics and other problem materials with greater speed and accuracy.

Graver Opens Western European Office

Graver Water Conditioning Co., New York, N. Y. has announced the opening of a Western European Office under the direction of Mr. Jorgen Berring, European Sales Engineer. Graver's new office is arranged to handle the sale, installation and servicing of all types of industrial and municipal water treatment and industrial waste treatment equipment throughout the Scandinavian countries and Western Europe. Mr. Berring will be located at 51 Toldbodgade, Copenhagen, K., Denmark.

Mr. Berring graduated from the University of Denmark with a Master of Degrees in Mechanical Engineering and is experienced with European industrial and export-import problems. He is well versed in all phases of these fields, having actively engaged in water and waste treatment problems for many years. He has spent additional time in various departments of the Graver company and is completely equipped to assist in all phases of water treatment.

(Continued on page 100A)


Variable capacities, with constant pressure at high efficiency
Heavy, rugged construction...minimizing noise and vibration
Adaptable to high speed, direct connected drives
Low maintenance ...long-time dependability

LOOK FOR THE "BIG 4"

WHEN YOU BUY CENTRIFUGALS

Your specific needs may dictate other important characteristics in centrifugal blowers or exhausters. But even so, these four values are essential to over-all successful performance. You'll find them in every Roots-Connersville Centrifugal Unit, regardless of size. And if you desire variations to suit your application, the ability to meet these needs is a heritage of our 100 years' specializing in equipment to handle gas and air.

You'll find first-cost economies, too, in the wide range of capacities of R-C Centrifugals. From 2,000 cfm to 100,000 cfm, you can choose the single-stage or multi-stage unit most closely matched to your individual requirements. You can count on the same high quality of performance that has made many thousands of first-time buyers enthusiastic, repeat customers for R-C equipment.

For your present or future requirements, we suggest you call on Roots-Connersville, for 100 years the specialists in handling gas and air.

CENTENNIAL 1854 1954

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
354 Mount Ave. • Connersville, Indiana

BLOWER BUILDERS SINCE 1854

Specialists in handling gas and air

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Drake Named President of Pennsalt's Industrial Chemicals Division

Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., has announced that William P. Drake has been named President of the new Industrial Chemicals Division.

In his new capacity Mr. Drake will be responsible for both the manufacture and sale of Pennsalt's extensive line of industrial chemicals. Other major operating divisions of the consolidated company are the Chemical Specialties Division; the Pennsylvania Salt Manufacturing Company of Washington; Sharples Chemicals, Incorporated; and the Pennsalt International Corporation.

Mr. Drake joined Pennsalt in 1934 as a student trainee while still enrolled in Bowdoin College. Following completion of training he served successively as salesman, sales supervisor, product sales manager and general sales manager. In 1949 he was elected a Vice President of the Company.

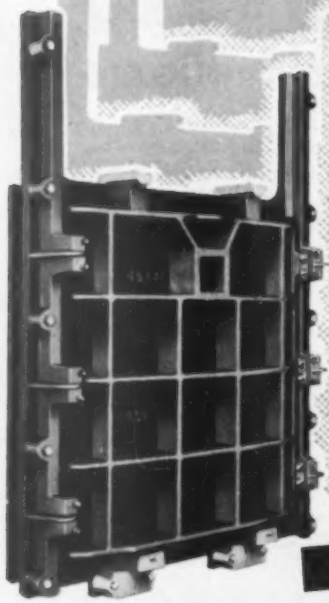
For six months in 1952, on loan to the government, Mr. Drake served as Director of the Rubber, Chemical & Drug Division, Office of Price Stabilization. He is a director of the Chlorine Institute, Inc., and the Main Belting Co. of Philadelphia.

Pekrul Grows

To keep pace with the ever increasing demand for PEKRUL GATES over half a century, MORSE BROS. MACHINERY has just completed an extensive modernization program. The installation of many new machines and facilities, an increased engineering staff, and complete, new, custom re-tooling specifically for PEKRUL GATE production means...

modern design and superior engineering service...

even faster PEKRUL GATE deliveries to you...

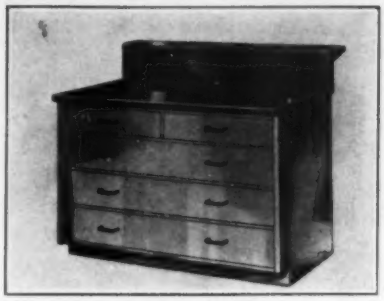


PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
DENVER, COLORADO

MANUFACTURERS OF PEKRUL GATES FOR

Flood Control · Sewage Disposal · Rearing Ponds · Recreation Pools
Levees · Reservoirs · Irrigation · Cooling Towers · Pumping Plants
Water Works · Oil Refineries · Steel Mills · Dams · Fish Hatcheries



New Lab Unit For King-Size Glassware

803

Fisher Scientific Co., Pittsburgh, Pa., has developed a new four-foot all-drawer unit for storing large laboratory glassware.

The unit has three deep (6") roomy drawers running the full width of the 48" cabinet. Two half-width drawers at the top hold beakers, stoppers, test tubes, filter paper, and small apparatus.

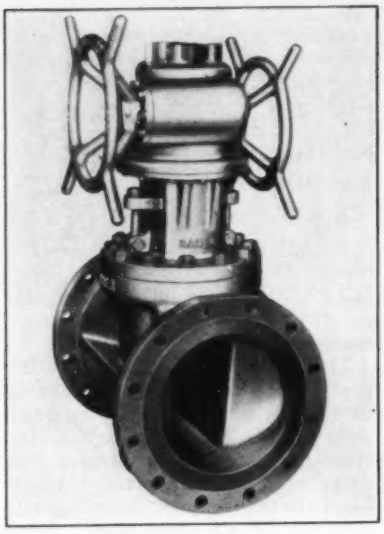
The three four-foot drawers take the longest burettes and Liebig condensers, the big 100 and 200-ml delivery pipettes that don't fit in anything else, and other oversize glassware.

Rockwell Opens Unique Meter and Valve Testing Station

Rockwell Manufacturing Co., Pittsburgh, Pa., has announced the opening of the world's largest meter and valve testing station built expressly for testing meters and valves under actual operating conditions. Built on the outskirts of Pittsburgh, the station was designed for tests on meters and valves used in the measurement and control of gasoline and oil, water, chemicals, beverages and other fluid products. The station may eventually be expanded to include other test facilities.

Occupying about an acre of a four-acre terraced hillside plot owned by the company, the new station consists of two aluminum-sheathed one-story buildings, a row of petroleum storage tanks, a bulk station loading rack and more than a half a mile of above-ground piping.

Special facilities are provided for tests with viscous petroleum products, gasoline, fuel oil and liquified petroleum gas. Five above-ground storage tanks with a combined capacity of 35,000 gallons are laid out in a row behind, and at an elevation some 20 feet above, an outdoor concrete testing area. The height differential permits the use of gravity feed when desired.



New 10-Inch, 12-Inch Plug Valves

804

Hamer Oil Tool Company, Long Beach, California, has announced the development of two new balanced-type Plug Valves, the Hamer 10-inch and Hamer 12-inch.

Currently being produced in ASA 150# and 300# classes, the new plug valves are available in carbon steel, as well as other materials to meet the demands of almost any service conditions. Chain wheel attachments for overhead operation are available on both models.

Extremely versatile, the new Hamer Plug Valves can be operated with or without lubricant. They are equipped with lubrication fittings through which an ordinary medium grade of grease may be applied to the packing and bearing surfaces. Valves are so designed that the lubricant fills the balance chambers first; grease will not enter the line unless an excessive amount is applied. Where lubrication absolutely is prohibited, these valves will operate effectively with the lubricator hole plugged.

Precision Machine Co. Changes Name

Precision Machine Company, Somerville, Mass..2 has announced that the company name has been changed to the Precision Chemical Pump Corporation. The address remains the same: 8 Walnut Street, Somerville, Mass.

The new Corporation will continue production of the Precision chemical pumps and slurry pumps.

High Speed Diversion Valve

805

Kieley and Mueller, Inc., Middletown, N.Y., has announced a new three-way, cylinder-operated valve that combines high travel with extreme speed on both the pressure stroke and spring return.

When used as an emergency diversion valve with less than 100 psi on the cylinder, full travel with tight shut-off is accomplished in 0.5 second. On spring return, the same high speed operation can be achieved. Use of the spring return, rather than double-acting cylinders, permits the valve to fail in either the open or closed position as required for maximum safety under emergency conditions. Valve is designed also for the use of auxiliary equipment such as explosion-proof signal contacts or solenoid pilots which feed or bleed for on-off operation through pipe rather than small instrument tubing. Cylinders may be actuated by air, suitable gases or any normal fluid actuating medium.

While the three-way, cylinder-operated valve is provided with quick-operating ports for emergency service, it is also available with V-ports and valve positioners for throttling applications.

Valves may be supplied in any machineable metal in standard sizes from ½" to 10" with either Teflon or greased lubricant stuffing boxes. Position indicators with an accessible open yoke of all steel shock-proof construction are standard.

Bailey Meter Moves Philadelphia Office

The Philadelphia District Office of Bailey Meter Company, Cleveland, Ohio, has announced that they have moved to larger quarters at 29 Bala Ave., Bala Cynwyd, Pa.

Under the managership of H. C. Tanner, the Philadelphia District Office is staffed by Instrument Engineers C. E. Hatton, G. H. Hill, C. C. Holtsman, D. W. Moyer, J. F. Triolo, and Resident Engineers L. R. Kent and W. B. Martin in Baltimore, Md., and H. D. Vollmer, Jr. in Richmond, Va. These engineers are specialists in flow measurement, combustion and automatic control applications.

The Philadelphia District includes eastern Pennsylvania, Southern New Jersey, Delaware, central and eastern Maryland, Washington, D. C., and the central and eastern portions of Virginia.

(Continued on page 102A)

WANT THE EASIEST WAY TO MAKE FAST, ACCURATE pH, CHLORINE TESTS ?

TAYLOR COMPARATORS

EASIEST... three simple steps give you the answer. Every set contains all reagents and accessories needed.

FAST . . . most tests take only a few seconds, others only a few minutes. All sets are lightweight, portable so you can make on-the-spot tests anywhere in the plant. No time wasted carrying samples back to the lab.

ACCURATE... *all liquid color standards carry an unlimited guarantee against fading.*

All standards for any one determination are housed in sturdy plastic slide. No single standards to handle.

See Your Dealer Soon!

FREE MANUAL

"Modern pH and Chlorine Control" gives theory and application, illustrates and describes full Taylor line. Write today.

W. A. TAYLOR AND CO.

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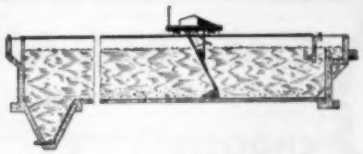
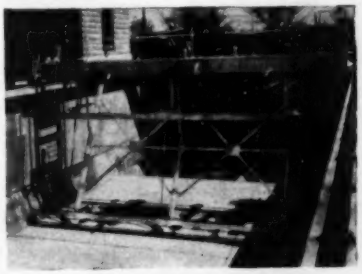


Rectangular Clarifiers



Particularly suitable where space is limited or where sludge delivery is desired at one end of tank. Consists of a bridge crane spanning width of the tank supporting sludge scraper and skimmer, which move automatically back and forth.

Many of these units are now operating in sewage plants throughout the country.

This unit has also proven highly successful as an oil-water separator in the treatment of oil refinery waste water. Bulletin 31-D-15

HARDINGE COMPANY, INCORPORATED

YORK PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco

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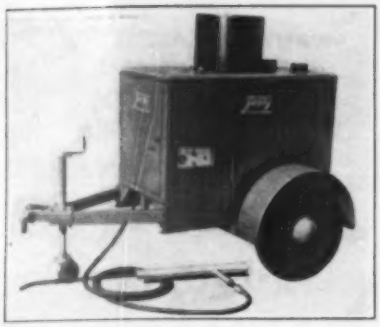


Steam Cleaners

806

Homestead Valve Manufacturing Company, Coraopolis, Pa., has announced a new series "3000" Hypressure Jenny Steam Cleaner for superduty cleaning jobs. The cleaners feature a single heating coil, with oil-fired burner, and sufficient volume to supply up to four cleaning guns.

Available in the trailer-mounted type, or as shop portable, or stationary units, Series "3000" Hypressure Jenny may be had with a choice of electric motor or gasoline engine drive. Automatic electric ignition instantly starts the unit which delivers a full powered cleaning blast of 300 gallons per hour within 3 minutes from a cold start; or 100 gallons per hour if the unit is to be used for heat transfer purposes. Twenty-six gallon capacity fuel and solution tanks provide ample fuel and concentrated cleaning solution for continuous operation, and metering controls on both the fuel and solution lines enable the operator to get maximum cleaning at lowest cost.

Foxboro To Build New Factory in California

The Foxboro Company, Foxboro, Mass., has announced that ground has been broken for a new branch factory to be erected at 399 Preda Street, San Leandro, California. Scheduled for completion by August 15, the new 8400 square foot building will more than double the production area of the present San Francisco shop and provide increased facilities for the manufacture, sales and service of instruments and accessories.

Commenting on the new factory, B. H. Bristol, president of the company, pointed out that the West Coast move is part of a threefold expansion of Foxboro's nation-wide instrument production and service facilities to meet the growing demand for process instrumentation. A new Dallas factory, recently completed, will serve industries of the South and Southwest. In addition, a site has been selected and construction started for a new Pittsburgh factory to be completed in the near future.

New Spun-Fiber Nylon Cloth For Rotary Filters

807

Filtration Fabrics Division of Filtration Engineers, Inc., Newark, N.J., has announced a new weave of spun nylon filter cloth that has solved many cloth-blinding problems.

Designated FEON No. 287, the new cloth is working successfully on continuous filters running materials such as corn gluten, sewage sludge, silica gel, etc. Less expensive than many other nylon weaves, the new Feon cloth increases filtering efficiency of rotary filters, saves "downtime" for washing up or changing cloths, and makes all the long-life advantages of nylon available for many new applications.

The non-blinding property of this spun nylon cloth is due to the structure of the threads. Whereas nylon thread twisted from continuous filaments is smooth, the spun-fiber thread has many fiber ends protruding from its surface.

THE "ALL AMERICAN" CITY

CANTON, OHIO

CHOOSES "Flexibles" OF COURSE

Last year Canton was named an "All America" City by the National Municipal League and LOOK Magazine, being one of 11 cities so designated during 1953. It received a merit certificate for outstanding achievement in city government among other honors and recognition.

Naturally, like other modern, well-run cities, Canton uses and endorses "Flexible" sewer cleaning equipment. Pictured is one of its "Flexible" Bucket Machines in the process of getting a sizeable heap of mud and other obstructions out of a typical sewer manhole. Floyd Walters is operating, Ralph Swinehart is dumping the bucket, Don Skotnicky is standing by. They are working in safety and with dignity above ground on the street level... instead of "in the sewers," as was required of sewer maintenance crews in the years "Before Flexibles."

"Flexibles" cut sewer cleaning costs—permit preventative maintenance to be carried out—operate in all weather. There is a model for every need. We invite the opportunity to give your city an "on the job demonstration."

Write for our FREE Catalog

Flexible SALES CORPORATION

3786 Durango Ave., Los Angeles 34, Calif.

(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

New "Electronic Witch" M-Scope Pipe Finder

808

Fisher Research Laboratory, Palo Alto, Calif., has announced new Pipe Finder, the Electronic Witch. This new electronic instrument features greatly improved operational and overall field performance for locating and tracing buried pipes, conduits and metal objects. A completely new electronic circuit is used as well as new and more durable interior and exterior components.

The instrument cabinets are an attractive red moulded fiberglass that is practically indestructible. This new material is impervious to water and will not scratch, stain, splinter, or bend.

The conventional wound multiturn antenna loops and beat oscillator type circuit have been completely eliminated. The new circuit is exceedingly stable for all field applications, and is insensitive to temperature changes and the shock and vibration of rugged every day field use. The "B" battery consumption is over 50% less than that of the average of all currently produced instruments of a similar nature. To the consumer this means that the "B" batteries will last about three times as long between battery changes. The "A" batteries will last fully twice as long.

The receiver selectivity and the instrument operational frequency combine to make the new "Electronic Witch" much less sensitive to all types of outside interference, and particularly that associated with neon signs and overhead power lines. Further, the circuit design employs readily replaceable components. The tubes and batteries are standard and easily replaced in the field.

A new Super Sensitive 97 db gain fluid leak detector circuit has been incorporated into the new "Electronic Witch." This further increases the field usability since every "Electronic Witch" pipe finder can be used as an emergency leak detector.

(Continued on page 104A)

In water and Sewage Treatment Plants....

HOMESTEAD *Lubricated* **PLUG VALVES**

PROVIDE **the lowest cost-per-year fluid control**

... of any Valve within Their Service Range

BECAUSE

- **They are pressure sealed and chemical sealed**
- **They automatically adjust for wear**
- **Need less lubricant**
- **Low first cost; low upkeep**

Extra long leakless service and low operating costs are assured by Homestead's exclusive *self-sealing, wedge-acting,* two-piece plug. *Under line pressure,* it *automatically adjusts for wear* as wear occurs, thereby keeping the closely fitted seating surfaces in constant contact to maintain a drop-tight seal. *Full lubricant seal* around ports and a triple head seal give additional assurance of long, trouble-free service.

Next time you order valves, specify HOMESTEAD *Self-Seald, Lubricated* PLUG VALVES and prove them to your own satisfaction. We can furnish them in semi-steel or cast steel; 100% port area or Venturi; 1½ in. to 14 in.; for steam working pressures to 150 lbs.; air-water-gas to 200 lbs.

Also available in one-piece plug design.

For full information, MAIL THE COUPON TODAY.

Please send me VALVE REFERENCE BOOK No. 39-5 on Homestead Self-Seald Lubricated Plug Valves.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

HOMESTEAD VALVE MANUFACTURING COMPANY

"Serving Since 1892"

P. O. BOX 42 CORAOPOLIS, PA.

Two New Vice Presidents Elected at Pennsalt

Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., has announced establishment of two new offices.

Dr. William Alfred LaLande, Jr., was elected vice president and will continue as Manager of Research & Development, and Edward F. Beale, who was also named vice president, is Treasurer of the Company."

Dr. LaLande, a graduate of the University of Pennsylvania, joined Pennsalt in 1944, and has been directing Pennsalt's research & development program at Wyndmoor (Pa.) since 1948. From 1927-37 he served as a member of the faculty of the University of Pennsylvania and during the following year, did post-doctoral work in organic chemistry at the Swiss Federal Polytechnic Institute in Zurich. From 1938 to 1944 he was Director of Research & Development for the Attapulgus Clay Company.

Mr. Beale attended the William Penn Charter School and is an alumnus of Princeton University. From 1937-40 he was associated with the National Lead Co., becoming Treasurer and Controller of its John T. Lewis & Bros. Co., subsidiary, in 1940. Following separation from the military service in 1946 he joined Pennsalt as Assistant-to-the-Treasurer and was named Controller in 1948 and Secretary and Treasurer in 1951.

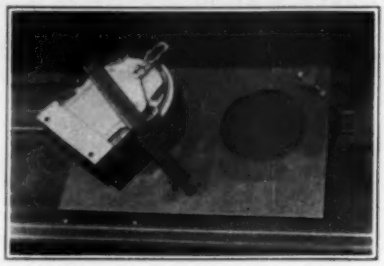
FLEXIBLE BOLTED CONNECTION

Savings in joint making time and labor costs, plus leak-proof flexibility, all combine to increase the demand for M & H Gate Valves with Mechanical Joint end connections. M & H Mechanical Joints are made in accordance with A. S. A. standard specifications A21.11, 1952, with glands, gaskets and bolts interchangeable with Standardized Mechanical Joints for cast iron pipe as furnished by all pipe companies who are members of the Cast Iron Pipe Research Association.

This joint uses the stuffing box principle, by which a thick gasket of triangular cross section is compressed into a stuffing box by a bolted follower ring or gland. Mechanical joint making in the field does not require skilled workmen. The joint's flexibility permits deflection in any direction, longitudinal expansion or contraction without leakage.

Mechanical Joint ends are available on all types of M & H Gate Valves, manufactured in accordance with American Water Works Association specifications, sizes 2 to 36 inches. For complete information, write or wire M & H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION



Meter Shelves for Carry-All Truck Bodies

809

Morrison Steel Products, Inc., Buffalo, New York, is now offering new Meter Shelves for use with their Carry-All Bodies. The addition of these shelves make the Carry-All unit an ideal body for meter installation and servicing.

There are two types of the new accessories, one is designed for use in the horizontal compartments located one on each side of the Carry-All Body. These compartments will hold two Meter Shelves side-by-side, each of which will carry two 5-L meters for a total of four per horizontal compartment. The other shelf designed for installation in the vertical front compartments will hold one 10-L meter. Each front vertical compartment will hold two of these shelves. Thus, a Carry-All Body completely equipped with the new accessories will carry eight 5-L meters and four 10-L meters. The meters are held securely in place against padded supports by adjustable flexible straps. Danger of damage to meters in transit, resulting from carrying them loose in the truck, is completely eliminated. Both the Morrison Carry-All Body and these new accessories are designed for easy loading, unloading and handling of the meters.

Drastrup Elected To Board of A. M. Byers

A. M. Byers Company, Pittsburgh, Penna., has announced that A. B. Drastrup, recently elected executive vice president, has been elected a member of the Board of Directors of the firm.

Mr. Drastrup fills a vacancy on the board created by the resignation from the company, effective May 1, of J. W. Marrinan. Mr. Marrinan had served as vice president in charge of operations and a director since 1931. He had been with the firm 38 years.

Direct-Reading Dissolved Oxygen Analyzer

810

Dorber Co., Chicago, Ill., has developed a dissolved oxygen analyzer which operates as simply as a modern pH meter. The instrument, an amperometric type, employs a rotating platinum electrode with a unique, stable electronic system which automatically translates diffusion current into units of dissolved oxygen concentration. The instrument determines dissolved oxygen from 0 to 10 ppm within 5% of the true value for most aqueous solutions. It operates on 115 V A.C. and is not affected by power line voltage fluctuations.

An important feature is that, unlike the conventional Winkler test for dissolved oxygen, this new instrument is not subject to interference by dissolved iron, calcium, magnesium, sulfides, nitrites, or organic matter. Samples can be colored or turbid.

Business and Industry Film Producing Company Formed

Gilbert Altschul, a six time International and National Motion Picture Award Winner, has announced the formation of Gilbert Altschul Productions. Formerly, senior motion picture producer-director of Coronet Films, where he gained eight years of experience preparing film material for schools, he is now producing films for public relations programs of business and industry.

According to Mr. Altschul, the leaders of American industry, research and commerce, have at their disposal one of the most powerful devices of communication in the motion picture. To be really effective, though, films must be expertly designed, integrated with existing sales and public relations programs, and wisely used.

To help them perform this service, the new organization has available to it, experienced and fully qualified film technicians and craftsmen.

Headquarters for the new company is 1760 Clavey Road, Highland Park, Illinois.

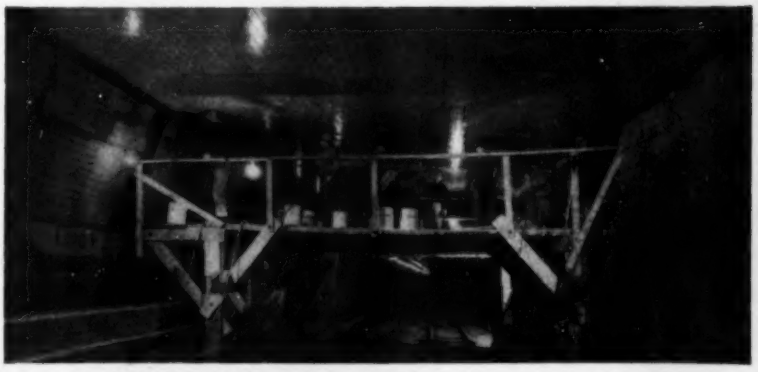
(Continued on page 106A)

Underneath the river!

THORITE Patching Mortar Crew at work in Air Tunnel under East River, New York.

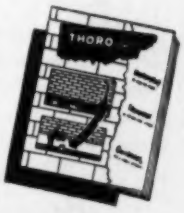
Sealing Leaks in Traffic Tunnel with WATERPLUG.

Sealing Drain Pipe Channels in Tunnel with WATERPLUG.



WATERPLUG Crew at work, before placing of tile lining, Battery Tunnels, East River, New York.

On many of the largest underground projects in the Americas and in foreign countries, WATERPLUG solves, for the contractor, his water problems. The job may be small or it may be large, the results are the same — Successful.



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Standard Dry Wall Products

BOX X, NEW EAGLE, PENNSYLVANIA

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Diaphragm Pumps

811

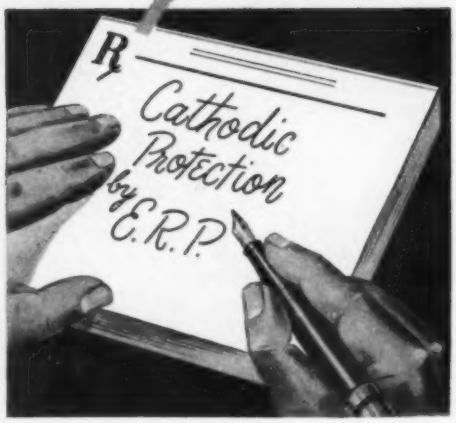
Rice Pump & Machine Company, Belgium, Wisconsin, is now employing modern automotive type design to reduce bulk and weight in their new line of Diaphragm Pumps which they are now bringing onto the market to round out their pump line.

These pumps are available in the 2, 3 and 4-inch sizes and are powered with air-cooled gasoline engines or electric motors. All sizes are available with wheelbarrow, two wheel or base mounting.

Rice states that they are featuring the wheelbarrow, 1-wheel mounting, because of the ease with which one man can handle the pumps with this mounting on the job. When not in use or for shipping or storage these handles fold alongside. In the folded position they provide a rear support to the power deck when changing the diaphragm.

Other features include totally enclosed geared speed reduction cases to exclude dirt and water. The gears have cut helical teeth, operate in a bath of oil and turn on ground shafts and needle bearings.

℞ FOR CORROSION...



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E-27

W. F. Young

De Laval Opens St. Louis Sales Office

De Laval Steam Turbine Company, Trenton, New Jersey, has announced the opening of a new sales office in St. Louis and the appointment of William F. Young as sales engineer in charge. The new office is located at 25 South Bemiston Ave., St. Louis, Missouri, and it will operate as a branch sales office of the De Laval's Chicago District Office.

"Spirol-Mix" Flocculator

812

Graver Water Conditioning Co., New York, N. Y., has announced a new flocculator for conventional water treatment plants. Called the SPIROL-MIX Flocculator, the new unit is designed for vertical mounting in the flocculation basin. Water entering at the bottom of the basin is gently roll-mixed as it passes upwardly through the basin to the outlet at the top.

The unit consists of a variable-speed drive mechanism mounted on top of the basin and directly connected by a flexible coupling to a paddle-type mixer assembly within the basin. The mixer assembly consists of a vertical drive shaft to which blade support arms are attached. Load and thrust of the entire assembly is taken up by thrust bearings in the drive mechanism. The drive shaft is held in place at the bottom of the basin by a pressure, water-lubricated guide bearing.

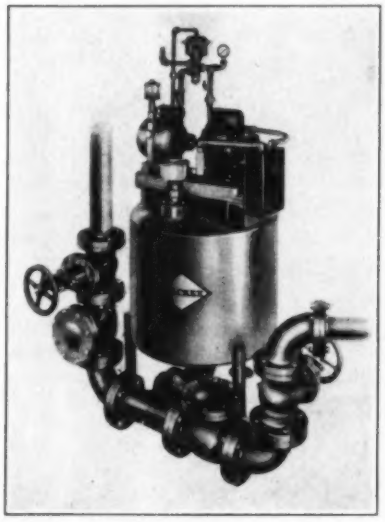
The pitch of each set of diagonal blades is slightly increased toward the central axis. This arrangement creates a propeller-like action which assures a gentle, uniform multi-swirling motion over the entire area of the basin.

The step arrangement of each set of diagonal blades results in a decrease in total blade area from the bottom to the top of the basin. Therefore, as the water rises in the basin, it is subjected to a decreased rate of agitation. This prevents the destruction of floc formed in the early part of the operation.

Executive Elections at Diamond Alkali

The Diamond Alkali Company, Cleveland, Ohio, has announced that Mr. Raymond F. Evans has been elected as Chairman of the Board and Mr. John A. Sargent as President of the Company. All 10 present directors were re-elected, and all other officers were renamed to present posts.

A spokesman for the Board explained that Mr. Evans, in the newly-created post as board chairman, will continue to function as chief executive officer of the company and will be especially concerned with long-range planning and policy making; while Mr. Sargent, as president, will direct the general, day-to-day management of the company activities. The executive vice-presidency, vacated by Mr. Sargent, will not be filled at this time.

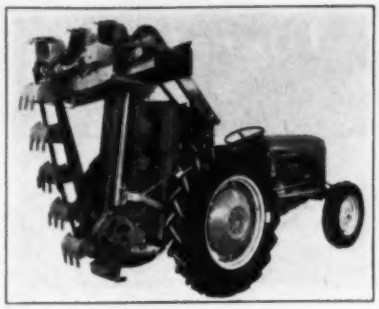


Low Volume Pneumatic Sewage Ejector

813

Yeomans Brothers Co., Melrose Park, Ill., has announced Packex—a packaged pneumatic ejector for low flows.

Packex is designed for capacities to 20 gpm with a 20 ft. head, and for use with either a 3 or 4 inch inlet and discharge fitting. A completely sanitary unit, it has an hermetically sealed pot to eliminate odor and gas. Also, the unit has no bearing in the pumping unit to wear, no stuffing boxes to repack, and no shafting to keep aligned. Packex will pass all solids that enter the pot. The unit is ready for inlet and discharge connections when it leaves the factory, and operates on standard house current.



Tractor Mounted Trencher

814

Earth Equipment Corp., Los Angeles, Calif., has developed a new Everett Trencher, a tractor-mounted, bracket-type trench-digger for Ford and Ferguson tractors. Design improvements include a new built-in rock guard; single-wheel design said to give faster penetration; new "V-belt" power drive; and new easily accessible controls.

The trencher cuts up to 42 inches deep in a width of 12 to 18 inches. Operating from the power take-off of the tractor, the unit is raised and lowered by a built-in hydraulic system. A V-belt safety slip feature is built into the drive of the trencher to stop the bucket line when obstructions are encountered.

Sales Organization Changes at Allis-Chalmers

Allis-Chalmers general machinery division, Milwaukee, Wis., has announced the following appointments in the sales staff:

O. V. Tally, director of industrial sales; J. S. Morgan, director of utility sales, and W. L. Manly, director of general purpose equipment sales.

Announcement was also made of the formation of a new Northwest region under the management of M. M. York, formerly New England regional manager. This region will include the Chicago, Milwaukee, Minneapolis, Duluth, Davenport, Des Moines, Peoria, and Rockford offices with headquarters in Chicago.

J. H. Burrus, Jr., formerly Milwaukee district office manager, has been named manager of the Midwest region succeeding Tally, who held the post since 1950. This region now consists of the St. Louis, Indianapolis, Evansville, Louisville, Kansas City, Wichita, and Omaha offices, as well as the Memphis district. Headquarters are in St. Louis.

John E. Smet, formerly manager of the Hartford district office, was appointed manager of the New England region succeeding York.

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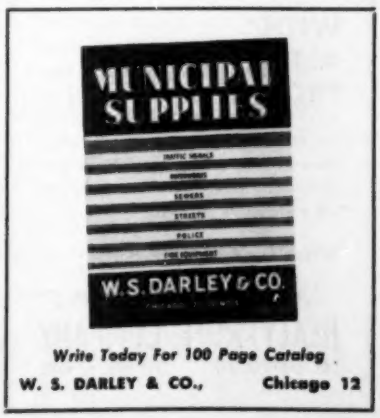

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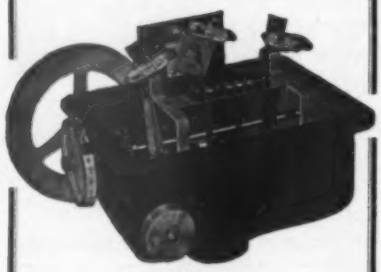

RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

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Literature & Catalogs

Time Saving Sump Pump Selector

815

Byron Jackson Co., Los Angeles, California, has just published a 20-page, two color BJ Sumpmaster Bulletin that contains all the answers to selecting any of 4000 or more sump pump models.

To use this valuable bulletin, you simply determine the desired GPM and total head, then turn to the Easy Selection Charts to find individual model number. You can detail pump installations without writing for additional information because, complete dimensions and outline drawings are included. Simple coding system even allows you to order without detailed description. Pump capacities range from 10 to 2600 GPM with heads from 20 to 300 ft. The bulletin is a real time-saving technical aid for engineers, operators, contractors, or any user of sump pumps.

Dorrco Hydro-Softener

816

The Dorr Company, Stamford, Conn., has announced the availability of a new four-page, two-color bulletin, "The Dorrco Hydro-Softener." It includes a description of the physical characteristics, sizes and capacities, operation, advantages, and applications of this new continuous water softener and cites operating data from a municipal installation. Illustrations include a graphic wash drawing and photograph of the Hydro-Softener and its basic components.

According to the bulletin the Dorrco Hydro-Softener is the first continuous base exchange type softener to be offered commercially. Continuous regeneration of expended resin in a separate column eliminates the need of periodic shutdowns as in conventional batch units. Basically it consists of two elements—a two compartment softening cell and a five compartment regeneration cell. Panel mounted controls provide for regulation and measurement of resin transfer, regenerating brine, and wash water flows.

Protective Coatings

817

Heresite & Chemical Company, Manitowoc, Wis., has available a catalog on **Heresite** and other protective coatings manufactured by the company.

The catalog discusses in detail the various formulations of the coatings and their protective abilities. Various industries and their uses of Heresite are given along with photographs of the equipment it is used on.

Pressure Joint for Clay Pipe

818

The Clay Sewer Pipe Association, Columbus, Ohio, has just published a fully-illustrated, 6-page brochure giving specifications, instructions and case histories of vitrified clay pipe installations utilizing the new **Pressure Joint.**

According to the brochure, the pressure joint is especially effective in high water table areas and in wet trench operations. The joint employs a rubber gasket inflated by hand with a special grout compound to form an infiltration-proof, self-aligning joint. Vitrified clay pipe with pressure joints reduce pipe laying costs, permit installation under all ground conditions, speeds installation, and improves flow characteristics.

Ring-Tite Couplings

819

Johns-Manville, New York, N.Y., has just published a 6-page illustrated folder on **Ring-Tite,** the new coupling for Transite Pressure Pipe.

The folder shows how the Ring-Tite Coupling goes together, points out installation time savings, explains economies in service and cites typical uses in various parts of the United States. Data on sizes and weights is included, and the folder gives basic information on the Transite asbestos cement pipe with which the coupling is used.

Heavy-Duty Backfiller

820

The Cleveland Trencher Company, Cleveland, Ohio, has just published a bulletin describing the new **Cleveland Model 190 Backfiller,** a heavy-duty machine for use on pipe lines and similar heavy construction projects.

The outstanding features of the big backfiller are effectively presented in brief copy, with each feature clearly pointed out and located on a large-scale photograph of the Model 190 reproduced on the 3-page inside spread of the bulletin.

The machine's one-man operation, its big 7 ft. backfill board, its balanced traction and its continuous operation of backfilling as it travels, are given special treatment on another page of the folder. Complete dimensional drawings and specifications of the Model 190 are given on the back cover.

Automatic Pump Sequence Control Systems

821

Fischer & Porter Company, Hatboro, Penna., has just published a catalog on **Automatic Pump Sequence Control Systems.** The catalog describes an improved automatic system for varying the number of pumps needed to satisfy fluctuating demands in multiple pump installations.

The catalog covers the principle of kinetic manometry—direct measurement of a constant percentage of main-line flow through an orifice and taps—is used to actuate a float with an armature attached. Changes in main-flow move the float up or down causing armature movement through the electro-magnetic field of one or more inductance coils. This inductance change is transposed electronically to an electric signal that either stops or starts—depending on direction of change—the pump corresponding to the coil through which the armature has moved.

How To Select a Motorpump

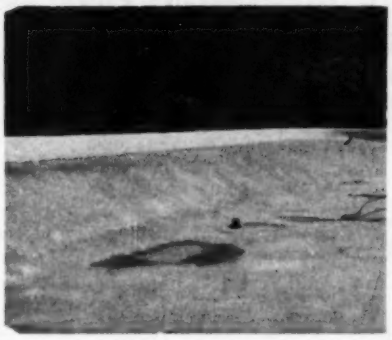
822

Ingersoll-Rand Company, New York, N.Y., has just published a very interesting and informative booklet on **How to Select A Motorpump.**

Actually this booklet is a slide film presentation in printed form. The original slide film was produced for the benefit of Ingersoll-Rand's distributors.

The booklet gives a brief description of what a centrifugal pump is and how it works. Then it points out the various factors, such as the quantity, pressure, friction losses and head that must be considered in selecting a pump to meet a specific installation. The next step is the presentation of a typical problem and its solution, by means of material shown on previous pages, such as charts and curves of various forms. Finally the "film-in-a-booklet" states the material recommended for various pumping installation and gives actual installation views.

(Continued on page 110A)



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Level and Pressure Control

823

Builders-Providence, Inc., Providence, R.I., has just published a bulletin on **Chronoflo Level and Pressure Telemeter.** The bulletin describes the application of Chronoflo Telemetering to level control in reservoirs and elevated and ground storage; to pressure control in pump discharge lines, distribution systems, booster stations, industrial processes, steam and gas lines; and to automatic pump control.

This 8-page bulletin includes features, description and illustrations of the transmitters and receivers, and diagrams of installation arrangements, together with explanatory material on application and operating features.

Fundamentals of Industrial Water Treatment Processes

824

Rohm & Haas Company, Philadelphia, Pa., has just compiled a 24-page booklet entitled **"If You Use Water."**

Illustrated liberally with two-color flow diagrams, the booklet discusses the fundamentals of the three major classifications of industrial water treatment based on ion exchange: softening, dealkalization, and deionization. Under each of these classifications, the booklet presents the major process variations. For example, the deionization section describes multiple and mixed bed systems and why different types of water supplies require different combinations of ion exchange resins and equipment to produce effluent water of a given quality.

The advantages of the various water treatment methods are discussed and interpreted in terms of the applications in specific industries.

Electric Hoist

825

Coffing Hoist Company, Danville, Illinois, has available a new, six-page, two-color bulletin on **Quik-Lift Electric Hoists.** Included in the bulletin are performance and safety features, cut-away drawings showing details of construction, together with complete specifications and dimensions of all 17 Quik-Lift models from 500 to 4,000-lb. capacities.

Also in the new bulletin are pictures and descriptions of various electric hoist accessories.

Valves For Instrument Piping

826

Jerguson Gage & Valve Company, Somerville, Mass., has just published a Data Unit on **Jerguson Valve For Instrument Piping and General Use.**

The Data Unit gives features, application information, and specifications on the valves. The Unit also contains illustrations and drawings showing how these valves combine unions, nipples, reducers, elbows, tees, valve, and drain valve into one space-saving unit.

Sludge Dryers

827

The Heil Company, Milwaukee, Wisconsin, has available a 4-page folder on the **Heil Ardriers.**

The folder gives a complete description of the operation and features of the dryer along with various applications. Photographs and diagrams of several installations are included.

Silent Chain Book

828

Link-Belt Company, Chicago, Ill., has just published a new 88-page **Silent Chain Book** containing detailed engineering data.

According to the book, the versatility of silent chain makes it suitable for a broad range of applications—from the tiny fractional horsepower drives to huge, rugged drives transmitting thousands of horsepower. The chain is noted for its ability to operate continuously at high speeds. Its proved efficiency of better than 98 percent is unaltered by wear, temperature and atmospheric conditions. Silent chain can be operated on short centers and at ratios as high as 10 to 1, according to the book.

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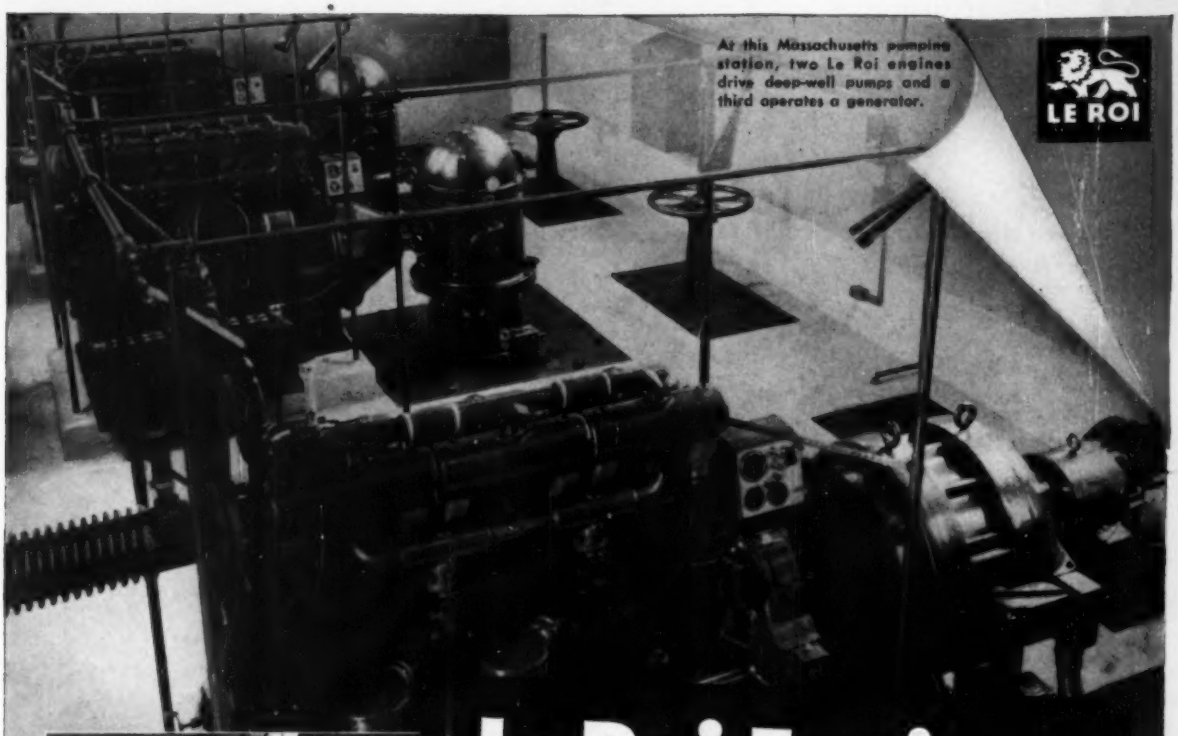

At this Massachusetts pumping station, two Le Roi engines drive deep-well pumps and a third operates a generator.

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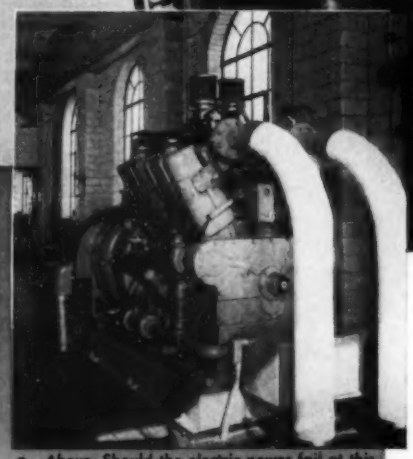

Above: Should the electric power fail at this Mississippi Lock and Dam, the Le Roi standby unit automatically swings into action — opening and closing locks or operating de-icers with consistent dependability.

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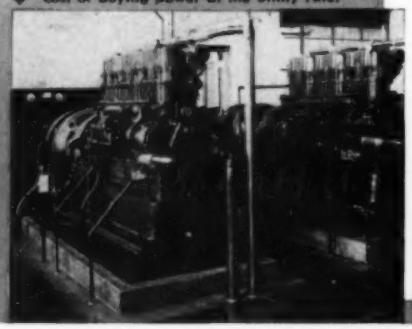

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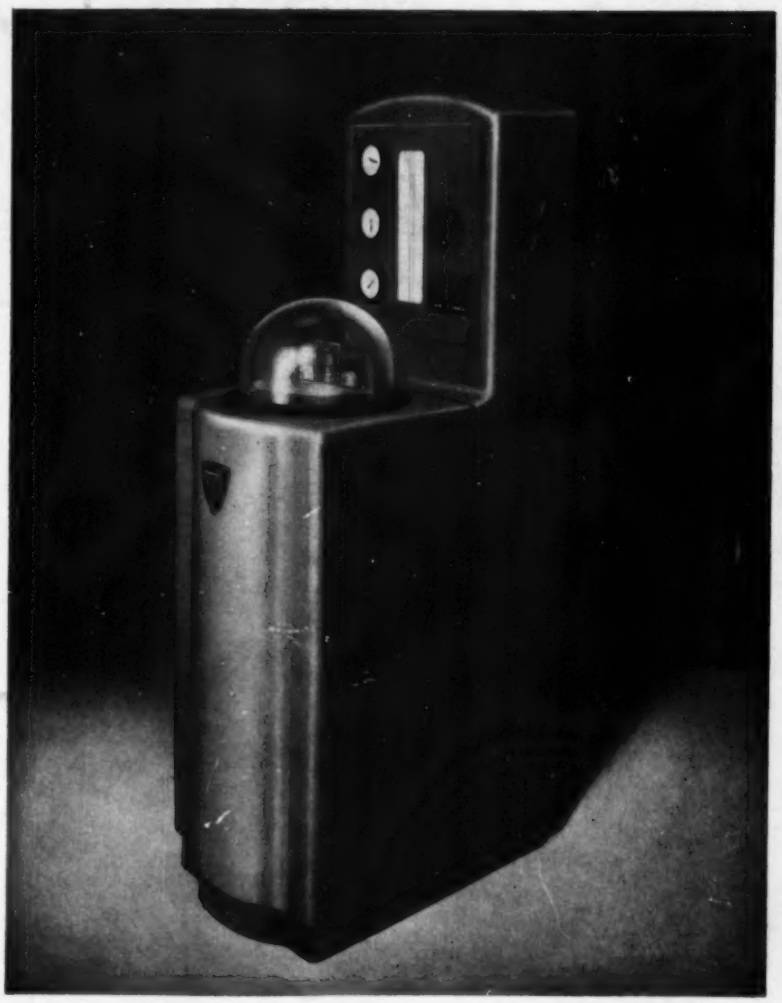

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